COEP Technological University Pune

(A Unitary Public University of Govt. of Maharashtra)

School of Engineering and Technology

Curriculum Structure with Evaluation Scheme First Year B. Tech. in Engineering

(F.Y. Structure Effective from: A.Y. 2025-26)

Curriculum of F.Y. B. Tech. in Engineering

Program Educational Objectives (PEOs)

After the completion of the program

I. Student will be employable in the diversified sectors of the industry, government organizations, public sector and research organizations.

II. Student will pursue higher education in engineering or other fields of their interests, at institutes of repute and high ranking.

III. Student will demonstrate effective communication, lifelong learning ability, integrity, team work, leadership qualities, concern to environment and commitment to safety, health, legal and cultural issues in the fields they choose to pursue.

Program Outcomes (POs):

Engineering Graduate will be able to:

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problem.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural science, and engineering sciences.

PO3: Design/Development Solution: Design solution for complex engineering problems and design system component or process that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, social and environmental conditions.

PO4: Conduct Investigation of Complex Problem: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusion.

PO5: Method, Tool Usage: Create, select and apply appropriately technique, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with understanding the limitation.

PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to access societal health, safety, legal and cultural and consequent responsibility relevantto the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solution in societal and environmental context, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principle and commitment to professional ethics and responsibilities and norms of the engineering practices.

PO9: Individual and Team Work: Function effectively as an individual, and as the member or leader in diverse team and multidisciplinary setting.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, and being able to comprehend and write effective reports and design documentation and effective presentation and give and receive clear instructions.

PO11: Project management and Finance: Demonstrate knowledge & understanding of the engineering and management principles and apply these to ones work, as the member and the leader in a team to manage projects and in multidisciplinary environment.

PO12: Life Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in broadest context of technological change.

List of Abbreviations

Abbreviation	Title
BS	Basic Science Course
ESC	Engineering Science Course
PCC	Programme Core Course (PCC)
PEC	Programme Elective Course (PEC)
OE/SE	Open/School Elective (OE/SE) other than particular program
MD M	Multidisciplinary Minor (MD M)
VSEC	Vocational and Skill Enhancement Course (VSEC)
HSMC	Humanities Social Science and Management
IKS	Indian Knowledge System (IKS)
VEC	Value Education Course (VEC)
RM	Research Methodology (RM)
--	Internship
--	Project
CEA	Community Engagement Activity (CEA)/Field Project
CCA	Co-curricular & Extracurricular Activities (CCA)

F.Y. B. Tech. Engineering

Semester -I

	Sr. No.	Course Title[#] /Collection[$]	L	T	P	S	Cr	Categorisation
Sem - I	01	Mathematics I	2	1	-	1	1.5	BSC
	02	Mathematics II	2	1	-	1	1.5	BSC
	03	Applied Sciences I	2	-	2	1	1.5	BSC
	04	Applied Sciences II	2	-	2	1	1.5	BSC
	05	Applied Sciences III	1	-	-	1	1	BSC (Optional either in SEM I or II)
	06	Engineering Sciences[$]	3	0	0	1	3	ESC
	07	Engineering Sciences[$]	2	0	2	1	3	ESC
	08	Engineering Sciences[$]	2	0	2	1	3	ESC
	09	Vocational and Skill Enhancement Courses[$]	1	-	2	2	2	VSEC
	10	Ability Enhancements Courses[$]	-	-	2	2	1	AEC
	11	Co-curricular Activities/ Liberal Learning Course[$]	-	-	2	2	1	CCA/LLC
							19/20	

F.Y. B. Tech. Engineering

Semester -II

	Sr. No.	Course Title[#] /Collection[$]	L	T	P	S	Cr	Categorisation
Sem - II	01	Mathematics III	2	1	-	1	1.5	BSC
	02	Mathematics IV	2	1	-	1	1.5	BSC
	03	Applied Sciences III	2	-	2	1	1.5	BSC
	04	Applied Sciences IV	2	-	2	1	1.5	BSC
	05	Applied Sciences[$]	1	-	-	1	1	BSC (Optional either in SEM I or II)
	06	Engineering Sciences[$]	2	-	2	1	3	ESC
	07	Program Core Course[#]	3	-	2	1	4	PCC
	08	Vocational and Skill Enhancement Courses[$]	1	-	2	2	2	VSEC
	09	Ability Enhancements Courses[$]	-	-	2	3	1	AEC
	10	Indian Knowledge System (Domain Specific)[#]	2	-	-	1	2	IKS
	11	Co-curricular Activities/ Liberal Learning Course[$]	-	-	2	2	1	CCA/LLC
							21/20	

Sr. No.	Course Code	Course Title[#] /Collection[$]	SEMESTER I	SEMESTER II	
01	BS	Mathematics (select any 1 subject 3 credits in I semester and 4 credits in II semester)	3	4	1. Matrix algebra and calculus (MAC) (3 credits) and Vector Calculus and Differential Equations (VCDE) (4 credits) Or 2. Linear Algebra (3 credits) and Probability and Statistics (PS) (4 credits)
02	BS	Applied Sciences (select any 1 subject 3 credits in I semester and 3 credits in II semester)	3	3	1. Engineering Physics (3 credits) and Engineering Chemistry (3 credits) 2. Engineering Chemistry (3 credits) and Engineering Physics (3 credits) 3. Engineering Physics (3 credits) and Quantum Physics (3 credits) 4. Engineering Physics (3 credits) and Semiconductor Physics (3 credits) 5. Engineering Chemistry (3 credits) and Semiconductor Physics (3 credits))
02	BS	Applied Sciences (select any 1 subject 1 credit in I or II semester)	1	--	1. Electromagnetism 2. Solid State Physics 3. Statistical Thermodynamics 4. Biology for Engineers 5. Emerging Technologies in Energy Storage 6. Nanomaterials in Emerging Technologies 7. Polymeric Materials in Engineering 8. Fundamental of Quantum physics
04	ESC	Engineering Sciences (select any 2 subject 3 credit for I Semester and II semester)	3 + 3		1. Basics of Civil Engineering (Civil) 2. Fundamentals of Physical Infrastructure (Civil - Planning) 3. AI for Multidisciplinary Applications (Computer) 4. Applied Electronics and IOT (Electronics) 5. Electrical Energy Utilization (Electrical) 6. Fundamentals of Measurement and Sensors (Instrumentation) 7. Foundations in Mechanical Engineering (Mechanical) 8. Nanomaterials (Metallurgy) 9. Basics of Manufacturing Technology (Manufacturing Science)
		Engineering Sciences (select any 1 subjects 3 credits for I			1. Applied Mechanics (Civil) 2. Fundamentals of Cyber Security (Computer) 3. Basic Electrical Engineering (Electrical) 4. Digital logic design (Electronics) 5. Engineering Graphics (Mechanical)

		semester and II semester)			6. Fundamentals of Corrosion Engineering (Metallurgy) 7. Product prototyping practices (Manufacturing Science) 8. Fundamentals of Electrical Engineering (Electrical) 9. Elements of Electronics Engineering 10. Fundamentals of MATLAB and Simulink
05	VSEC	Vocational and Skill Enhancement Courses (select any 1 subject 2 credits for I semester and 1 subject 2 credits for II semester)	2	2	1. Geomatic Engineering (Civil) 2. Fundamentals of Construction Practices (Civil) 3. Programming for problem solving (Computer) 4. Web design (Computer) 5. Python Programming (computer) 6. Electrical Maintenance and Safety (Electrical) 7. Electrical Workshop (Electrical) 8. Digital public infrastructure (Electronics) 9. Data preprocessing and visualization (Electronics) 10. Fundamentals of PLC (Instrumentation) 11. Computer-aided drafting (Mechanical) 12. EV Architecture (Mechanical) 13. Introduction to Materials Modelling (Metallurgy) 14. Modern chemical Analysis (Metallurgy) 15. Manufacturing practices and Fab Lab (Manufacturing Science) 16. Robotics and Drone Operation and Safety (Manufacturing Science)
06	AEC-01	Ability Enhancements Courses (select any 1 subject 1 credit for I semester and 1 subject 1 credit for II semester)	1	1	1. Personality Development (Management) 2. Communication Skills
07	CCA/ LLC-01	Co-curricular Activities/ Liberal Learning Course	1	1	

Mandatary subject as per programme

Sr.		Credits	Computer	AIML	Electrical	Electronics	Instrumentation	Civil	Mechanical	Metallurgy	Manufacturing Science
1	Engineering Sciences	3	Fundamentals of AI	Fundamentals of AI	Fundamentals of Electrical Engineering	Elements of Electronics Engineering	Fundamentals of MATLAB and Simulink	Essentials of Civil Engineering	Systems in Mechanical Engg	Structure & Properties of Materials	Design Thinking and Idea Lab
2	Programme Core Courses	4	Discrete structure	Discrete structure	Electrical and Electronic Measurements and Instrumentation	Foundation of Electronics and Emerging Technologies	Basics of Measurement and Sensor	Engineering Mechanics	Computer-Aided Engineering Drawing	Fuel furnaces and Refractories	Essentials of Production Systems and Smart Factories _For SEM-II
3	Indian Knowledge System	1	Common for all								

Matrix Algebra and Calculus-1(MAC-1)						
Course Code	MA(BS)-25001		**Examination Scheme**			
Teaching Scheme	2-1-0-1		**CIE**	20		
Credits	1.5		**SLE-1**	30		

Course Outcomes: Students will be able to:

1. Define matrices, linear equations, and determinants, recall basic matrix algebra, limits, continuity and derivatives of functions of single variable.
2. Solve a system of linear equations using matrices, verify MVTs, find Critical points and Monotonicity of functions of single variable.
3. Calculate eigen values, eigen vectors, rank of a matrix, find extreme values of functions.
4 . Apply concepts of calculus to find extrema of functions, including real life problems.
5. Apply concepts of Matrix Algebra and Calculus to various problems including real life problems.

Matrix Algebra: **[6 Hrs]**

Properties of Matrices and Determinants; Solutions of Systems of linear equations using Gauss Elimination method; Rank of a matrix; Eigen Values and Eigen Vectors, diagonalization of special matrices; Applications

S: Properties of Matrices and Determinants

Differential Calculus: **[6 Hrs]**

Functions of single variable; Limits: Standard limits and methods of evaluation, Continuity and Differentiability; Extreme Values of Functions, The Mean Value Theorems, Monotonic Functions and The First Derivative Test, Applied Optimization Problems.

S: Functions of single variable; Limits: Standard limits and methods of evaluation; Continuity and Differentiability

Self-Study (SS): Contribution of Indian Mathematicians **[6 Hrs]**

1. Aaryabhatta, Varah Mihir, Brahmagupta, Panini, Pingala etc.
2. Mathematics in Sulbasutras, Chandra Sutras
3. Interesting concepts in Vedic Maths

Textbooks:

[1]	Advanced Engineering Mathematics (10th edition) by Erwin Kreyszig, Wiley Eastern Ltd.
[2]	Thomas's Calculus (12th edition) by Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education.

Reference Books:

[1]	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
[2]	Elementary Linear Algebra (Sixth Edition) by R. Larson and D. Falvo, Houghton Mifflin Harcourt Publishing company, Boston, New York.

Note:

[1]	To measure CO1, questions may be of the type- define, identify, state, match, list, name etc.
[2]	To measure CO2, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.
[3]	To measure CO3, questions will be based on applications of core concepts.
[4]	To measure CO4, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.
[5]	To measure CO5, some questions may be based on self-study topics and comprehension of unseen passages.

Matrix Algebra and Calculus-2 (MAC-2)						
Course Code	MA(BS)-25002		**Examination Scheme**			
Teaching Scheme	2-1-0-1		**CIE**	20		
Credits	1.5		**SLE-2**	30		
Prerequisite:	MAC-1					

Course Outcomes: Students will be able to:

1.Define limits, continuity and derivatives of functions of Several variables, recall definite integrals and their properties.
2.Evaluate Beta, Gamma integrals, find extreme values of functions of Several variables.
3.Calculate area and volume of solids, evaluate double and triple integrals.
4.Apply concepts of calculus to find center of gravity and moment of inertia.
5.Apply concepts of Matrix Algebra and Calculus to various problems including real life problems.

Content: **[12 Hrs]**

Functions of Several Variables, Partial Derivatives, The Chain Rule, Extreme Values and Saddle Points. Beta function and Gamma Function; Double Integrals in cartesian and polar coordinates, Triple integrals in cartesian, cylindrical and spherical coordinates, change of order of integration, Applications of single, double and triple integration in finding area under a curve, volume of solids.
S: Beta function and Gamma Function, Area under a curve.

Self-Study (SS): Contribution of Indian Mathematicians **[6 Hrs]**

1. Aaryabhatta, Varah Mihir, Brahmagupta, Panini, Pingala etc.
2. Mathematics in Sulbasutras, Chandra Sutras
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Textbooks:

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[3]	To measure CO3, questions will be based on applications of core concepts.
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[5]	To measure CO5, some questions may be based on self-study topics and comprehension of unseen passages.

Vector Calculus and Differential Equations-1 (VCDE-1)					
Course Code	MA(BS)-25005	**Examination Scheme**			
Teaching Scheme	3-0-2-1	**CIE**	20	**CIE**	50
Credits	2	**SLE-1**	30		
Prerequisite:	MAC-1, MAC-2				

Course Outcomes: Students will be able to:

1. Understand basic concepts of ODE.
2. List types of ordinary differential equations, find Laplace Transforms of simple functions.
3. Solve different ODEs, find Fourier series expansions of periodic functions
4. Prove theorems, Solve ODEs using Laplace transform.
5. Apply concepts of ODEs to solve real life application problems.

Content: **[18 Hrs]**

First order Ordinary Differential Equations - Variable Separable, Homogeneous, Linear; Higher order linear equations with constant coefficients; Euler-Cauchy equations, non-homogeneous higher order linear differential equations with constant coefficients (method of undetermined coefficients and method of variation of parameters); Laplace Transform of simple functions, Inverse Laplace Transform, Properties and Theorems of Laplace Transforms; Applications to Initial and Boundary value problems, Fourier Series.

S: first order variable separable, homogeneous, Linear differential equations

Self-Study(SS): Contribution of Indian Mathematicians **[6 Hrs]**

1. Aaryabhatta, Varah Mihir, Brahmagupta, Panini, Pingala etc.
2. Mathematics in Sulbasutras, Chandra Sutras
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Textbooks:

[1]	Advanced Engineering Mathematics (10th edition) by Erwin Kreyszig, Wiley Eastern Ltd.

Reference Books:

[1]	Thomas' Calculus (14th edition) by Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education.
[2]	Calculus for Scientists and Engineers by K.D Joshi, CRC Press.
[3]	A course in Calculus and Real Analysis (1st edition) by Sudhir Ghorpade and Balmohan Limaye, Springer-Verlag, New York.
[4]	Applied Mathematics Vol.1 (Reprint July 2014) by P.N. Wartikar and J.N. Wartikar, Pune Vidhyarthi Griha Prakashan Pune.

Note:

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[3]	To measure CO3, questions will be based on applications of core concepts.
[4]	To measure CO4, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.
[5]	To measure CO5, some questions may be based on self-study topics and comprehension of unseen passages.

Vector Calculus and Differential Equations-2 (VCDE-2)					
Course Code	MA(BS)-25006	**Examination Scheme**			
Teaching Scheme	3-0-2-1	**CIE**	20	**CIE**	50
Credits	2	**SLE-1**	30		
Prerequisite:	MAC-1, MAC-2, VCDE-1				

Course Outcomes: Students will be able to:

1. Understand basic concepts of vector calculus, PDE
2. List types of partial differential equations, find directional derivatives, gradient.
3. Solve different PDEs, find divergence and curl of vector fields.
4. Apply concepts of Fourier Series to solve PDEs, evaluate line and surface integrals.
5. Apply concepts of vector calculus, PDE to solve real life application problems.

Vector Calculus: **[9 Hrs]**

Vectors in 2-Space, 3-Space, Dot and Cross Product of Vectors, Derivatives of Vector Valued Functions, Gradient of a Scalar Field and Directional Derivatives, Divergence and Curl of a Vector Field, Line, Surface and Volume Integrals and their inter relations to find work done, flux and divergence.

S: Vectors in 2-Space, 3-Space, Dot, and Cross Product of Vectors

Partial Differential Equations: **[9 Hrs]**

Method of Separation of Variables; Modelling and Solutions of one-dimensional diffusion equation, first and second order one-dimensional wave equation.

S: Modelling of one-dimensional diffusion equation

Self-Study(SS): Contribution of Indian Mathematicians **6 Hrs**

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[5]	To measure CO5, some questions may be based on self-study topics and comprehension of unseen passages.

Linear Algebra-1 (LA-1)						
Course Code	MA(BS)-25003		**Examination Scheme**			
Teaching Scheme	2-1-0-1		**CIE**	20		
Credits	1.5		**SLE-1**	30		

Course Outcomes: Students will be able to:

Define matrices, linear equations, and determinants, recall basic vector algebra.
Understand basic concepts such as vector spaces, linear dependence / independence of vectors, basis.
Analyse and calculate eigen values, eigen vectors, rank and nullity of a matrix.
Prove propositions and theorems.
Apply concepts of linear algebra to various problems including real life problems.

Matrices and linear equations: **[12 Hrs]**

Basic properties of matrices, row operations and Gauss elimination, Determinants, and their basic properties; Basic concepts in linear algebra: vector spaces, subspaces, linear independence and dependence of vectors, bases, dimensions. Row and Column spaces; rank; Applications to systems of linear equations.
S: basic properties of matrices, row operations, Determinants, and their basic properties

Self-Study(SS): Contribution of Indian Mathematicians **[6 Hrs]**

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Textbooks:

[1]	Elementary Linear Algebra (Sixth Edition) by R. Larson and D. Falvo, Houghton Mifflin Harcourt Publishing company, Boston, New York.

Reference Books:

[1]	Advanced Engineering Mathematics (10th edition) by Erwin Kreyszig, Wiley Eastern Ltd.
[2]	Linear Algebra (3rd edition) by Serge Lang, Springer.
[3]	Linear Algebra and its applications (4th edition) by Gilbert Strang, Cengage Learnings (RS).
[4]	Elementary Linear Algebra (10th edition) by Howard Anton and Chris Rorres, John Wiley, and sons.

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[4]	To measure CO4, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.
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Probability and Statistics-1 (PS-1)					
Course Code	MA(BS)-25007	**Examination Scheme**			
Teaching Scheme	3-0-2-1	**CIE**	20	**CIE**	50
Credits	2	**SLE-1**	30		

Course Outcomes: Students will be able to:

1. Recall and know basics of probability theory, R software, probability distribution.
2. Understand concepts of probability, probability distributions, and use of R software.
3. Evaluate probability of compound events, find probabilities using standard distributions
4. Prove theorems / statements, run standard programs on R.
5. Apply concepts of probability and statistics to various problems including real life problems

Introduction to 'R': [9 Hrs]

Introductory R language fundamentals and basic syntax, major R
data structures, Using R to perform data analysis, creating visualizations using R.
S: Plotting Histogram and heat maps in R

Descriptive statistics: [9 Hrs]

Measures of location and variation. Visualization of data: Frequency tables, bar diagrams, histograms, heat maps, other visualization tools. Review on introduction to combinatorics and probability theory, Probability distributions and random variable, Binomial, Poisson, Exponential
S: Bayes' Rule for conditional probability

Self-Study(SS): Contribution of Indian Mathematicians [6 Hrs]

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2. Mathematics in Sulbasutras, Chandra Sutras
3. Interesting concepts in Vedic Maths

Textbooks:

[1]	Christian Heumann, Michael Schomaker, Shalabh, Introduction to Statistics and Data Analysis, ISBN: 978-3-319-46160-1, DOI: 10.1007/978-3-319-46162-5, Publisher: Springer,Year: 2016.

Reference Books:

[1]	Ross S.M., Introduction to probability and statistics for Engineers and Scientists (8th Edition), Elsevier Academic press, 2014.
[2]	Ronald E, Walpole, Sharon L. Myers, Keying Ye, Probabilty and Statistics for Engineers and Scientists (9th Edition), Pearson Prentice Hall, 2007.
[3]	Tilman M. Davies, The book of R: A first course in Programming and Statistics (1st Edition), No Starch Press, USA, 2016.
[4]	Kishor S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications (2nd Edition), Wiley Student edition, 2008.

Reference Books for R Software:

[1]	Norman Matloff, The Art of R Programming - A Tour of Statistical Software Design, (1st Edition), No Starch Press, USA, 2011.
[2]	Sudha Purohit, Sharad Gore, Shailaja Deshmukh, Statistics using R (2nd Edition), Narosa Publications, 2019.
[3]	Randall Pruim, Foundations and Applications of Statistics - An introduction using R (2nd Edition), American Mathematical Society, 2018.
[4]	Hadley Wickham and Garrett Grolemund, R for Data Science: Import, Tidy, transform, Visualize and Model Data, (1st Edition), O'Reilly Publications, 2017.

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List of Experiments:	
[1]	Installation of R studio, Introduction to R Programming, Variables and Datatypes.
[2]	Data Frames, Introduction to function, Data Vectors.
[3]	Data representation tools using R: Histogram, Bar plot, heatmap, box plot, and pie chart (for inbuilt dataset, for external dataset, Data.csv and for data vector added to R.)
[4]	Probability using R: calculations in R for e.g., choose (n, p) command to calculate ways to select p objects out of n, defining a function PDF/CDF in R and finding probabilities, plotting the function in R
[5]	Finding probabilities using standard distributions: finding probabilities on Bernoulli distribution, binomial distribution, Finding probabilities on Poisson, exponential distribution

Probability and Statistics-2 (PS-2)					
Course Code	MA(BS)-25008	**Examination Scheme**			
Teaching Scheme	3-0-2-1	**CIE**	20	**CIE**	50
Credits	2	**SLE-2**	30		

Course Outcomes: Students will be able to:

1.Recall and know basics of estimation theory, Testing of Hypothesis.
2.Understand concepts of estimation, testing of hypothesis and use of R software.
3.Evaluate and test for basic statistical inference (t-test, z-test, F-test, $\chi 2$ –test, confidence interval, non-parametric tests), Use of statistical tables and data sets in R.
4.Prove theorems / statements, run standard programs on R.
5.Apply concepts of probability and statistics to various problems including real life problems.

Content: [18 Hrs]

Advanced R language fundamentals and syntax, major R commands
Normal, Central limit theorem, Estimation, basic tests such as t-test, z-test, F-test, χ^2 –test, Nonparametric tests: Sign test, Wilcoxon signed rank test. Linear and multivariate Regression.
S: Wilcoxon signed rank test

Self-Study(SS): Contribution of Indian Mathematicians [6 Hrs]

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Textbooks:

[1] Christian Heumann, Michael Schomaker, Shalabh, Introduction to Statistics and Data Analysis, ISBN: 978-3-319-46160-1, DOI: 10.1007/978-3-319-46162-5, Publisher: Springer, Year: 2016.

Reference Books:

[1] Ross S.M., Introduction to probability and statistics for Engineers and Scientists (8th Edition), Elsevier Academic press, 2014.

[2] Ronald E, Walpole, Sharon L. Myers, Keying Ye, Probabilty and Statistics for Engineers and Scientists (9th Edition), Pearson Prentice Hall, 2007.

[3] Tilman M. Davies, The book of R: A first course in Programming and Statistics (1st Edition), No Starch Press, USA, 2016.

[4] Kishor S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications (2nd Edition), Wiley Student edition, 2008.

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[2] Sudha Purohit, Sharad Gore, Shailaja Deshmukh, Statistics using R (2nd Edition), Narosa Publications, 2019.

[3] Randall Pruim, Foundations and Applications of Statistics - An introduction using R (2nd Edition), American Mathematical Society, 2018.

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[2] To measure CO2, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.
3] To measure CO3, questions will be based on applications of core concepts.
[4] To measure CO4, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.

[5]	To measure CO5, some questions may be based on self-study topics and comprehension of unseen passages.
List of Experiments:	
[1]	Finding probabilities on Normal distribution using R: Finding probabilities on Exponential distribution using R
[2]	Finding probabilities using sampling distributions: Chi-square distribution, T-distribution and F-distribution using R.
[3]	Testing of hypothesis using R: z test, t test
[4]	Testing of hypothesis using R: Chi-square distribution, F distribution.
[5]	Nonparametric test: Sign test, Wilcoxon sign rank test.

Engineering Physics 1 (EP1)						
Course Code	AS(BS)-25001		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**CIE**	20	**CIE**	50
Credits	1.5		**SLE-1**	30		

Course Outcomes: Students will be able to:

Understand fundamentals of quantum mechanics and apply to one dimensional motion of particles.
Band structure of solids, categorization of solids based on band structure, ideas about Fermi level positions in semiconductors.
demonstrate and verify phenomenons of optics using experimental methods
study and analyze dielectric materials using experimental methods

Unit 1: Quantum Mechanics **[6 Hrs]**

Matter waves, Properties of matter waves, Physical significance of wave function. Schrödinger's time dependent and time independent equations, Operators, Eigen values and Eigen functions, Expectation values, Applications of Schrödinger's equation; Motion of a free particle, Electron in an infinite deep potential well (rigid box),

Unit 2: Solid State Physics **[6 Hrs]**

Solid State Physics
Band theory of solids, Energy level splitting in a solid as a function of interatomic distance. Band formation in Silicon. Fermi-Dirac probability function, Nearly free electron theory (E-k curve), classification of solids on the basis of band theory

Unit 3: Indian Knowledge System (IKS) Self-study: **[6 Hrs]**

1. Concepts of Matter and Energy:
2. Ancient Indian texts regarding nature of matter and energy, offering perspectives that can be explored alongside modern physics theories.
3. Ancient Indian Astronomy:
4. The astronomical knowledge and models developed in ancient India including the celestial bodies, eclipses, and planetary movements, which can be compared with modern astronomical knowledge.

Textbooks:

[1]	Introduction to quantum mechanics / David J. Griffiths
[2]	A text book of Engineering physics, Avadhanulu and Kshirsagar, S. Chand Pub.
[3]	Concepts of Modern Physics, Arthur Beiser; Tata McGraw – Hill Edition.
[4]	Introduction to Solid State Physics, Charles Kittel, Wiley.
[5]	Solid State Physics, S. O. Pillai, New Age International Publishers.
[6]	Introduction to Solid State Physics, Charles Kittel, Wiley.
[7]	Solid State Physics, S. O. Pillai, New Age International Publishers.

List of Experiments/Assignments:

[1]	Determination e/m by Thomson's method
[2]	Determination of Brewster's angle for a glass surface and Refractive index of a glass
[3]	Linear absorption coefficient using G. M. Counter
[4]	Experiment on X-ray diffraction
[5]	Dielectric constant

Engineering Chemistry-1						
Course Code	AS(BS)-25003		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**CIE**	20	**CIE**	50
Credits	1.5		**SLE-1**	30		

Course Outcomes: Students will be able to:

1. Explain analytical principles and apply suitable techniques to assess material properties in engineering applications.
2. Identify types of electrochemical energy storage systems, explain emerging battery technologies.
3. Apply theoretical knowledge for practical use and solve engineering problems.
4. Design and carry out scientific experiments, accurately record and analyze the results of experiments.

Unit 1: Analytical Techniques for Engineers **[6 Hrs]**

Role of materials in engineering fields, Basics of qualitative and quantitative analysis, Emerging trends and applications of analytical techniques, Overview of instrumental methods of analysis: Spectroscopy (UV and IR), Microscopy Chromatography, Thermogravimetry, etc
One analytical technique in detail.

Unit 2: Electrochemical energy storage systems **[6 Hrs]**

Significance of energy storage systems, Classification of high energy electrochemical energy storage systems, Battery characteristics, New emerging batteries - principle, construction, working, advantages and applications.

Unit 3: Indian Knowledge System (IKS) Self-study: **[6 Hrs]**

1. Traditional Indian Knowledge in Materials, Energy, and Analytical Sciences and the Role of Ancient Chemists.

Textbooks:

[1]	Instrumental Methods of Chemical analysis: Willard Dean, *Merritt*, Tata *McGraw* Hill Limited.
[2]	Instrumental Methods of Chemical analysis: Gurdeep R. Chatwal, Himalaya Publishing house.
[3]	A textbook of Engineering Chemistry: Jain and Jain, Dhanpat Rai Publishing Company
[4]	A textbook of Engineering Chemistry: S. S. Dara, S. Chand Publication.
[5]	A textbook of Engineering Chemistry: Shashi Chawla, Dhanpat Rai & Co. Ltd.
[6]	Battery Technologies: Materials and Components: Prof. Jianmin Ma, Wiley
[7]	Advanced Battery Technology: Powering the Future Peter A. Maxwell

List of Experiments/Assignments:

[1]	Standardization of Alkali and Quantitative Determination of Acid Strength
[2]	pH-metric analysis of a sample solution using pH-meter.
[3]	Analysis of inorganic solution by spectroscopic method (colorimetry).
[4]	Determination of Coefficient of Viscosity by Ostwald's Viscometer
[5]	Case Study based on Electrochemical energy storage systems

Engineering Chemistry-2						
Course Code	AS(BS)-25004		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**CIE**	20	**CIE**	50
Credits	1.5		**SLE-2**	30		

Course Outcomes: Students will be able to:

1. Explain the fundamental concepts, types, and mechanisms of corrosion and evaluate the factors influencing corrosion in engineering materials.
2. Analyze corrosion and water-related industrial problems and apply appropriate techniques for their prevention and treatment.
3. Apply theoretical knowledge for practical use and solve engineering problems.
4. Design and carry out scientific experiments, accurately record and analyze the results of experiments.

Unit 1: Corrosion and material protection **[6 Hrs]**

1. Introduction to corrosion and its impact on engineering materials
2. Mechanisms of corrosion phenomena.
3. Types/forms of corrosion,
4. Factors responsible for enhancing rate of corrosion
5. Various corrosion prevention techniques.

Unit 2: Water Technology **[6 Hrs]**

1. Sources of water and impurities are present in it.
2. Characteristics of hardwater -hardness in water and its determination by EDTA method and numericals.
3. Effects of hard water for industrial use.
4. Various water softening techniques for industrial use.

Unit 3: Indian Knowledge System (IKS) Self-study: **[6 Hrs]**

1. Ancient Indian Knowledge in Corrosion Resistance, Material Preservation and Water Technologies and the Role of Ancient Chemists.

Textbooks:

A textbook of Engineering Chemistry: Jain and Jain, Dhanpatrai Publication.

A textbook of Engineering Chemistry: S. S. Dara, S. Chand Publication 2010 edn.

A textbook of Engineering Chemistry: Shashi Chawla, Dhanpatrai Publication.

List of Experiments/Assignments:

1. Complexometric method for hardness determination of water.
2. Determination of caustic and bicarbonate alkalinity of water sample.
3. Precipitation method for chloride determination of water.
4. Weight Loss Method to Determine Corrosion Rate of Iron in Different

Engineering Physics 2 (EP2)						
Course Code	AS(BS)-25002		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**CIE**	20	**CIE**	50
Credits	1.5		**SLE-2**	30		

Course Outcomes: Students will be able to:

1. Analyze the intensity variation of light due to interference, diffraction and polarization.
2. They will be able to implement these phenomena to design advanced optical instruments.
3. Understand the principle, construction and working of lasers in order to implement Laser Technology in engineering field.
4. demonstrate and verify phenomenons of optics using experimental methods
5. determine the size of obstacle using laser

Unit 1: Interference and Diffraction **[6 Hrs]**

Interference due to wedge shaped thin film (with derivation); conditions of minima maxima, Newton's rings, Applications of interference.

Fraunhoffer diffraction at a single slit; condition of maxima and minima, Plane diffraction grating (Diffraction at multiple slits) and applications based on diffraction.

Unit 2: Laser Physics **[6 Hrs]**

Introduction to laser, Spontaneous and stimulated emission of radiations, Thermal equilibrium, Condition for Light amplification, Population inversion, Pumping (Three level and four level pumping), Optical resonator, Laser beam characteristics, Ruby laser, Nd-YAG Laser, He-Ne Laser, Semiconductor Laser, Engineering applications of Laser (Fiber optics, Laser material interaction).

Unit 3: Indian Knowledge System (IKS) Self-study: **[6 Hrs]**

1. **Concepts of Matter and Energy:**
2. Ancient Indian texts regarding nature of matter and energy, offering perspectives that can be explored alongside modern physics theories.
3. **Ancient Indian Astronomy:**
4. The astronomical knowledge and models developed in ancient India including the celestial bodies, eclipses, and planetary movements, which can be compared with modern astronomical knowledge.

Textbooks:

[1]	Fundamentals of Optics, Francis A. Jenkins and Harvey E. White; Mc-Graw Hill International Edition.
[2]	A text book of Engineering physics, Avadhanulu and Kshirsagar, S. Chand Pub.
[3]	Concepts of Modern Physics, Arthur Beiser; Tata McGraw – Hill Edition.

List of Experiments/Assignments:

[1]	Diffraction experiment with laser
[2]	To determine the wavelengths of light of a given source using diffraction grating
[3]	Newton's Rings
[4]	Determine the diameter of thin wire using laser diffraction.
[5]	Numerical aperture of optical fiber

Foundation of Quantum Physics						
Course Code	AS(BS)-25016		**Examination Scheme**			
Teaching Scheme	2-0-0-1		**CIE**	20		
Credits	1		**ESE**	30		

Course Outcomes: Students will be able to:

1. Derive and solve Schrödinger's time-dependent and time-independent wave equations for simple quantum systems.
2. Apply Schrödinger's equation to quantum systems such as free particles, particles in infinite, finite potential wells and harmonic oscillator.
3. Explain the phenomenon of quantum tunneling and its implications in microscopic systems.

Unit 1:	**Wave Mechanics**	**[7 Hrs]**

Matter waves, De-Broglie's concept of matter waves, Properties of matter waves, Heisenberg's uncertainty principle, Schrödinger's time dependent and time independent equations, Operators, Eigen values and Eigen functions, Expectation values, Physical significance of wave function.

Unit 2:	**Electrons in Potential Well**	**[7 Hrs]**

Applications of Schrödinger's equation; Motion of a free particle, Electron in an infinite deep potential well (rigid box), Electron in a finite deep potential well (non-rigid box), concept of quantum tunneling, Linear Harmonic oscillator

Unit 3:	**Indian Knowledge System (IKS) Self-study:**	

Concepts of Matter and Energy:

Ancient Indian texts regarding nature of matter and energy, offering perspectives that can be explored alongside modern physics theories.

Ancient Indian Astronomy:

The astronomical knowledge and models developed in ancient India including the celestial bodies, eclipses, and planetary movements, which can be compared with modern astronomical knowledge.

Textbooks:

[1]	Concepts of Modern Physics, Arthur Beiser; Tata McGraw – Hill Edition.
[2]	Modern Physics, Jeremy Bernstein, Paul M. Fish bane, Stephen Gasiorowics;
	Pearson Education.
[3]	Quantum Mechanics, L. J. Schiff; Mc-Graw Hill International Edition.

Quantum Physics 1 (QP1)						
Course Code	AS(BS)-25005		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**CIE**	20	**CIE**	50
Credits	1.5		**SLE-1**	30		

Course Outcomes: Students will be able to:

1. apply the role of uncertainty principle in quantum physics.
2. operate the Schrodinger equation to solve 1Dquantum mechanical system.
3. differentiate between quantum mechanical and classical behavior of fundamental particles.
4. calculate parameter associated with Photosensitive cathodes

Unit 1: Wave properties of particles **[6 Hrs]**

Wave packets, motion of wave packets, phase velocity, group velocity, relation between phase and group velocity, Heisenberg's uncertainty principle (HUP) with proof. Electron diffraction and γ- ray microscope, Applications of HUP: Bohr radius, β-decay and ground state energy calculation of Harmonic Oscillator.

Unit 2: Applications of the Schrodinger's wave equation **[6 Hrs]**

Schrödinger's time dependent and time independent equations (with derivation), Potential barrier and quantum tunneling, Harmonic oscillator (1D) and Hydrogen atom (qualitatively)

Unit 3: Indian Knowledge System (IKS) Self-study: **[6 Hrs]**

1. **Concepts of Matter and Energy:**
2. Ancient Indian texts regarding nature of matter and energy, offering perspectives that can be explored alongside modern physics theories.
3. **Ancient Indian Astronomy:**
4. The astronomical knowledge and models developed in ancient India including the celestial bodies, eclipses, and planetary movements, which can be compared with modern astronomical knowledge.

Textbooks:

[1]	Modern Physics, 6thEdition, Arthur Beiser, Shobhit Mahajan, S Rai Choudhury
[2]	Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths
[3]	A Textbook of Quantum Mechanics, 2nd Edition, P. M. Mathews, K. Venkatesan
[4]	Quantum Mechanics – Theory and Applications, 3rd Edition, A. K. Ghatak, S. Lokanathan
[5]	Quantum Mechanics by L. I. Schiff
[6]	Modern Quantum mechanics by J. J. Sakurai
[7]	Quantum Mechanics: Concepts and Applications, 2nd edition by N. Zettili, Wiley Pub

List of Experiments/Assignments:

[1]	Photoelectric effect
[2]	Plank's constant
[3]	Frank and Hertz
[4]	Electron diffraction
[5]	Compton Effect

Quantum Physics 2 (QP2)						
Course Code	AS(BS)-25006		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**CIE**	20	**CIE**	50
Credits	1.5		**SLE-2**	30		

Course Outcomes: Students will be able to:

1. apply operators to obtain physical properties of a particle.
2. evaluate the expectation value of an operator using matrix formalism.
3. Perform measurements of fundamental constants using quantum principles
4. differentiate between quantum mechanical and classical behavior of fundamental particles.
5. Perform handson on IBM quantum platform

Unit 1: Operators in Quantum Mechanics **[6 Hrs]**

Hermitian operator, position, momentum operator, angular momentum operator, total energy operator (Hamiltonian), commutator algebra, commutator brackets using position, momentum and angular momentum operator, Ladder operator, concept of parity, parity operator, Projection operator, Unitary operator, Eigen values and simultaneous Eigen function.

Unit 2: Many Electrons Atoms **[6 Hrs]**

Concept of electron spin, Spin angular momentum with Stern - Gerlach experiment, Pauli Matrices, Expectation value of an operator and Density matrix formalism for two level – spin ½ systems (Qubits).

Unit 3: Indian Knowledge System (IKS) Self-study: **[6 Hrs]**

1. **Concepts of Matter and Energy:**
2. Ancient Indian texts regarding nature of matter and energy, offering perspectives that can be explored alongside modern physics theories.
3. **Ancient Indian Astronomy:**
4. The astronomical knowledge and models developed in ancient India including the celestial bodies, eclipses, and planetary movements, which can be compared with modern astronomical knowledge.

Textbooks:

[1]	Modern Physics, 6thEdition, Arthur Beiser, Shobhit Mahajan, S Rai Choudhury
[2]	Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths
[3]	A Textbook of Quantum Mechanics, 2nd Edition, P. M. Mathews, K. Venkatesan
[4]	Quantum Mechanics – Theory and Applications, 3rd Edition, A. K. Ghatak, S. Lokanathan
[5]	Quantum Mechanics by L. I. Schiff
[6]	Modern Quantum mechanics by J. J. Sakurai
[7]	Quantum Mechanics: Concepts and Applications, 2nd edition by N. Zettili, Wiley Pub

List of Experiments/Assignments:

[1]	Stefan's law
[2]	Stern Gerlach experiment
[3]	Zeeman Effect
[4]	Hydrogen spectra lines
[5]	Electron charge measurement using Millikan's oil drop method
[6]	Quantum gates on IBM quantum platform

Semiconductor Physics 1 (SP1)						
Course Code	AS(BS)-25007		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**CIE**	20	**CIE**	50
Credits	1.5		**SLE-1**	30		

Course Outcomes: Students will be able to:

1. To calculate conductivity of solids using concepts of band theory
2. To measure conductivity as a function of charge distribution in energy band
3. Identify the type of semiconductor
4. Calculate carrier concentration and electrical conductivity of the given semiconductor

Unit 1:Band theory of Solids **[6 Hrs]**

Classification of solids on the basis of band theory, Fermi-Dirac distribution function, Electron and hole concentrations in semiconductors, Position of Fermi level in intrinsic and extrinsic semiconductors.

Unit 2: Electrical properties of Semiconductors **[6 Hrs]**

Intrinsic density, Intrinsic conductivity, Extrinsic conductivity, Law of mass action, Temperature variation of carrier concentration in extrinsic semiconductors, Electrical conduction in extrinsic semiconductor, Diffusion length and mean life time, Hall Effect.

Unit 3: Indian Knowledge System (IKS) Self-study: **[6 Hrs]**

1. **Concepts of Matter and Energy:**
2. Ancient Indian texts regarding nature of matter and energy, offering perspectives that can be explored alongside modern physics theories.
3. **Ancient Indian Astronomy:**
4. The astronomical knowledge and models developed in ancient India including the celestial bodies, eclipses, and planetary movements, which can be compared with modern astronomical knowledge.

Textbooks:

[1]	A text book of Engineering physics, Avadhanulu and Kshirsagar, S. Chand Pub.
[2]	Concepts of Modern Physics, Arthur Beiser; Tata McGraw – Hill Edition.
[3]	Introduction to Solid State Physics, Charles Kittel, Wiley.
[4]	Solid State Physics, S. O. Pillai, New Age International Publishers.
[5]	Solid state electronic devices, Ben G. Streetman, Sanjay Banerjee Pearson Prentice-Hall.

List of Experiments/Assignments:

[1]	Band gap of a semiconductor by four probe method
[2]	Hall effect in Semiconductor
[3]	Magnetoresistance measurement of semiconductor
[4]	Characterization of LED
[5]	Solar cell simulator

Semiconductor Physics 2 (SP2)						
Course Code	AS(BS)-25008		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**CIE**	20	**CIE**	50
Credits	1.5		**SLE-2**	30		

Course Outcomes: Students will be able to:

1. Describe the formation of a p-n junction and the nature of the space charge region.
2. Analyze the internal potential barrier and energy band structure in equilibrium and under bias conditions.
3. To design semiconductor devices using semiconductors
4. calculate parameter associated with semiconductor diodes and transistors
5. analyse device characteristics

Unit 1: Physics of Semiconductor diode **[6 Hrs]**

Formation of p-n junctions, space charge region, thermal equilibrium condition, position of Fermi level in equilibrium, Internal Potential Barrier, p-n junction under forward bias, Energy band structure, carrier movements in forward bias, p-n junction under reverse bias, Energy band structure, Diode equation, I-V characteristics in forward and reverse bias

Unit 2: Semiconductor Devices **[6 Hrs]**

Light emitting diode, Photodiode: Quantum efficiency, Responsivity, Maximum Photocurrent, transistor, transistor structure, formation of depletion region, energy band diagram, roles of emitter, base and collector, transistor configurations, transistor as an amplifier and Numericals.

Unit 3: Indian Knowledge System (IKS) Self-study: **[6 Hrs]**

1. **Concepts of Matter and Energy:**
2. Ancient Indian texts regarding nature of matter and energy, offering perspectives that can be explored alongside modern physics theories.
3. **Ancient Indian Astronomy:**
4. The astronomical knowledge and models developed in ancient India including the celestial bodies, eclipses, and planetary movements, which can be compared with modern astronomical knowledge.

Textbooks:

[1]	A text book of Engineering physics, Avadhanulu and Kshirsagar, S. Chand Pub.
[2]	Concepts of Modern Physics, Arthur Beiser; Tata McGraw – Hill Edition.
[3]	Introduction to Solid State Physics, Charles Kittel, Wiley.
[4]	Solid State Physics, S. O. Pillai, New Age International Publishers.
[5]	Solid state electronic devices, Ben G. Streetman, Sanjay Banerjee Pearson Prentice-Hall

List of Experiments/Assignments:

[1]	To determine the reverse saturation current and material constant of PN Junction
[2]	Transistor characteristics
[3]	Characteristics of Avalanche Photodiode
[4]	Characteristics of LED
[5]	Study of Zener diode

Electromagnetism						
Course Code	AS(BS)-25009		**Examination Scheme**			
Teaching Scheme	2-0-0-1		**CIE**	20		
Credits	1		**ESE**	30		

Course Outcomes: Students will be able to:

1. Understand the fundamentals of electromagnetism.
2. Apply Maxwell's equations to describe and analyze electromagnetic fields in free space and materials.
3. Derive and interpret electromagnetic wave equations and calculate the velocity of electromagnetic waves in free space.

Unit 1: Electromagnetics **[6 Hrs]**

Differential and integral calculus: Operator, Concept of gradient, divergence and curl. Line, surface and volume integrals, Gauss–Divergence theorem, Stokes theorem, Equation of continuity, Divergence of magnetic induction, Biot Savart's law, Ampere's circuital law.

Unit 2: Electrodynamics **[6 Hrs]**

Faraday's law of electromagnetic induction, generalization of amperes law, Maxwell's equations, Electromagnetic wave equations, Maxwell's wave equation for free space, Velocity of electromagnetic wave.

Unit 3: Indian Knowledge System (IKS) Self-study: **[6 Hrs]**

1. **Concepts of Matter and Energy:**
2. Ancient Indian texts regarding nature of matter and energy, offering perspectives that can be explored alongside modern physics theories.
3. **Ancient Indian Astronomy:**
4. The astronomical knowledge and models developed in ancient India including the celestial bodies, eclipses, and planetary movements, which can be compared with modern astronomical knowledge.

Textbooks:

[1]	Engineering Physics, Avadhanulu and Kshirsagar.
[2]	Classical Electrodynamics, J. D. Jackson, Wiley Publishers.
[3]	Introduction to Electrodynamics, D. J. Griffiths, Springer Publication.

Solid State Physics (SSP)						
Course Code	AS(BS)-25010		**Examination Scheme**			
Teaching Scheme	2-0-0-1		**CIE**	20		
Credits	1		**ESE**	30		

Course Outcomes: Students will be able to:

1. Different types of structure of solids and its characterization by x-ray technique
2. Origin of magnetism, various types of magnetic materials and its use in modern technology

Unit 1:Structure of Solids and its Characterization **[6 Hrs]**

Crystalline state, lattice, space lattice, basis and crystal structure, unit cell and primitive cell, lattice parameters, crystal systems in brief (cubic, monoclinic …Triclinic), Miller indices, inter planer distance of lattice plane, linear density, planar density and density of crystals, X-ray diffraction: Bragg spectrometer, analysisof XRD spectra for cubic system.

Unit 2: Magnetism & Superconductivity **[6 Hrs]**

Introduction to magnetic materials (dia, para, ferro, antiferro, ferri), types of magnetic interactions, Curie law in paramagnetism (using statistical partition function), application: magnetic storages. Introduction to superconductivity, properties of superconductor, Type-I and Type-II superconductors, Concept of cooper pair, DC Josephson effect.

Unit 3: Indian Knowledge System (IKS) Self-study: **[6 Hrs]**

1. **Concepts of Matter and Energy:**
2. Ancient Indian texts regarding nature of matter and energy, offering perspectives that can be explored alongside modern physics theories.
3. **Ancient Indian Astronomy:**
4. The astronomical knowledge and models developed in ancient India including the celestial bodies, eclipses, and planetary movements, which can be compared with modern astronomical knowledge.

Textbooks:

[1]	Elements of X-ray Diffraction, B. D. Cullity, Addison-Wesley Pub.
[2]	Introduction to Solid State Physics, Charles Kittel, Wiley.
[3]	Text Book of Engineering Physics by Avadhanulu& Kshirsagar, S. Chand Pub.
[4]	Introduction to Magnetic Materials, B. D. Cullity, Wiley.
[5]	Introduction to Magnetism and Magnetic Materials, David Jiles, Springer-Science.

Statistical Thermodynamics						
Course Code	AS(BS)-25011		**Examination Scheme**			
Teaching Scheme	2-0-0-1		**CIE**	20		
Credits	1		**ESE**	30		

Course Outcomes: Students will be able to:

1. Understand foundation of statistical mechanics, basic concepts and various terms and formulations.
2. Understand the connection between statistics and thermodynamics, understanding thermodynamics by statistical point of view and its techniques.

Unit 1: Statistical Mechanics **[6 Hrs]**

Micro and macro states, basic postulate of statistical mechanics, concept and types of ensembles, partition function, classification of statistical distribution function, Maxwell Boltzmann statistics (MBS), Bose Einstein (BES) and Fermi Dirac statistics (FDS)

Unit 2: Statistical Thermodynamics **[6 Hrs]**

Corollary of first law of thermodynamics, second and third law, statistical interpretation of basis thermodynamic variables; pressure, work, energy, entropy, Helmholtz free energy, Gibb's free energy

Unit 3: Indian Knowledge System (IKS) Self-study: **[6 Hrs]**

1. **Concepts of Matter and Energy:**
2. Ancient Indian texts regarding nature of matter and energy, offering perspectives that can be explored alongside modern physics theories.
3. **Ancient Indian Astronomy:**
4. The astronomical knowledge and models developed in ancient India including the celestial bodies, eclipses, and planetary movements, which can be compared with modern astronomical knowledge.

Textbooks:

[1]	Introduction to Solid State Physics, Charles Kittel, Wiley.
[2]	Fundamentals of Statistical Mechanics, B.B.Laud

BIOLOGY FOR ENGINEERS (BFE)			
Course Code	AS(BS)-25012	**Examination Scheme**	
Teaching Plan	2-0-0-1	**CIE**	20
Credit/s	1	**ESE**	30

Course Outcomes: Students will be able to:

1. Recognize the correlation in Biology and Engineering domain
2. Reiterate the fundamental concepts in Biology and analogy
3. Integrate the Biological concepts in Engineering field
4. Appraise the applications of Biological processes through the Engineering interventions
5. Connecting Indian Knowledge System with modern bioengineering

Unit 1: Crosstalk between biology and engineering **[2 Hrs]**

a) Biologically inspired technologies
b) Contribution of engineering in biological domain
c) Analogy of biological organ/system and engineering device/mechanism Organ & system

Unit 2: Organization of Living Machines **[2Hrs]**

Molecules and Biomolecules, structure-based function and engineering applications of biomolecules, Organization of life forms, Energy dynamics in biological systems

Unit 3: Concepts in Bioengineering **[4Hrs]**

Civil: Designs in nature, plumbing labs in biological organization
Mechanical: Mechanical properties of cells, tissues and organs, heat transfer in human body
Manufacturing: Manufacturing lines of carbohydrates, ATP's and proteins
Metallurgy: Types and properties of biomaterials
Electrical: Electrical signalling in biology, Bioelectricity - Analogy of photosynthesis and working of solar cells.
Electronics: Cell to cell communication, Principle Biomedical imaging and sensing mechanisms
Computer: Acquisition, processing and transmission of biological data

Unit 4: Application areas of Bioengineering **[4Hrs]**

Civil: Bio concrete, biological water treatment, Bioremediation
Biomechanics: Applications of Biomechanics, Prosthesis and rehabilitation, Ergonomics
Biomanufacturing: Bioprinting - 3D printing of biological tissues and organs
Biomaterials: Biomining, Diverse applications of biomaterials
Bioelectricity: Bioelectricity in humans, Microbial Fuel Cell
Bioelectronics: Examples and applications of Biosensors and Biomedical imaging
Bioinstrumentation: Diagnostic and Therapeutic devices
Biocomputing: Biological algorithms, Databases & Biocomputing
Application of **Artificial Intelligence & Machine Learning** in biological domains, **Biomimetics -** Nature inspired material and mechanisms

Unit 5: Indian Knowledge System (IKS) Self-study:

History of Indian Knowledge System in biological areas like traditional medicine; Cultural, spiritual and ecological significance of living organisms in traditional Indian system; Connect of Indian Knowledge with the modern concepts of sustainability

Textbooks:

[1]	Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2000). Lehninger principles of biochemistry. New York: Worth Publishers.
[2]	Eggins BR. (1006) Biosensors: An Introduction. John Wiley & Sons Publishers.
[3]	Palsson B.O. and Bhatia S.N. (2009) Tissue Engineering. Pearson.
[4]	Susan Hockfield (2019) The Age of Living Machines – How Biology Will Build the Next Technology Revolution

[5]	Shu Chien, Peter C Y Chen & Y C Fung (Ed.) (2000) An Introductory Text to Bioengineering. World Scientific.
	Web Resources:
	NPTEL Course on Biology for engineers and other non-biologists (4 weeks UG Course) By Prof. G.K. Suraishkumar & Prof. Madhulika Dixit (IIT. Madras)

Emerging Technologies in Energy Storage						
Course Code	AS(BS)-25013		**Examination Scheme**			
Teaching Scheme	2-0-0-1		**CIE**	20		
Credits	1		**ESE**	30		

Course Outcomes: Students will be able to:

1. Understand the significance, construction, and working principles of advanced batteries and fuel cells used in energy storage systems.
2. Evaluate innovations in sustainable energy systems through comparison of battery and fuel cell performance, and analysis of battery recycling, hydrogen production, storage, and safety practices.

Unit 1: Introduction to Advanced Batteries **[6 Hrs]**

1. Importance and Innovations in next-generation batteries for EVs, grid storage, and portable devices
2. Construction, working principle of Solid-State Batteries, Lithium–Sulphur and Lithium–Air Batteries, Sodium-Ion Batteries
3. Battery Recycling

Unit 2: Fuel Cells and Hydrogen Energy Systems **[6 Hrs]**

1. Fuel cell fundamentals: electrochemical conversion
2. Classification, operating principles, efficiency, and applications of PEMFC, SOFC, DMFC and AFC (one fuel cell in detail) Hydrogen Production, Storage & Safety

Unit 3: Self-study: Indian Knowledge System (IKS) **[6 Hrs]**

1. Traditional Indian Knowledge in Energy storage systems and the Role of Ancient Chemists.

Textbooks:

[1]	Lithium-ion and Lithium–Sulfur Batteries: Fundamentals to Performance- Sandeep A. Arote
[2]	Solid State Batteries – Palaniyandy, Abhilash & Nalini
[3]	Fuel Cells: Principles, Design, and Analysis - Shripad Revankar, Pradeep Majumdar, CRC Press.
[4]	Fuel Cell Fundamentals-Ryan O' Hayre, Suk-Won Cha, Wiley.
[5]	Handbook on Production, Recycling of Lithium Ion and Lead-Acid Batteries 2nd edition by P.K. Tripathi
[6]	Gupta, R. B., Hydrogen Fuel: Production, Transport and Storage, CRC Press, Taylor & Francis Group, 2009.

Nanomaterials in Emerging Technologies						
Course Code	AS(BS)-25014		**Examination Scheme**			
Teaching Scheme	2-0-0-1		**CIE**	20		
Credits	1		**ESE**	30		

Course Outcomes: Students will be able to:

1. Explain the classification, properties, synthesis techniques, and structure–property relationships of nanomaterials.
2. Analyze the functional behavior and potential applications of nanomaterials in emerging technologies.

Unit 1: Fundamentals of Nanomaterials and Synthesis Techniques **[6 Hrs]**

1. Introduction of Nanomaterials.
2. Classification of nanomaterials
3. Various Properties of nanomaterials
4. Synthesis of nanomaterials - Top Down and Bottom-Up Approach

Unit 2: Applications of Nanomaterials **[6 Hrs]**

1. In Electronics
2. In Sensors
3. In Health and medicine
4. In energy storage systems
5. As photocatalyst

Unit 3: Indian Knowledge System (IKS) Self-study: **[6 Hrs]**

1. Traditional Indian Knowledge in Nanomaterials and technology and the Role of Ancient Chemists.

Textbooks:

[1]	Introduction to Nanotechnology: Charles P. Poole, Frank J. Owens, Wiley.
[2]	Cao, G., *Nanostructures and Nanomaterials: Synthesis, Properties, and Applications*, World Scientific.
[3]	Poole, C. P., & Owens, F. J., *Introduction to Nanotechnology*, Wiley.
[4]	Rao, C. N. R., Müller, A., & Cheetham, A. K., *The Chemistry of Nanomaterials*, Wiley-VCH.
[5]	Mark Ratner & Daniel Ratner, *Nanotechnology: A Gentle Introduction to the Next Big Idea*, Pearson.
[6]	Research articles from IEEE Transactions on Nanotechnology, ACS Nano, Nano Letters, and Advanced Materials.

Polymeric Materials in Engineering						
Course Code	AS(BS)-25015		**Examination Scheme**			
Teaching Scheme	2-0-0-1		**CIE**	20		
Credits	1		**ESE**	30		

Course Outcomes: Students will be able to:

1. Describe the types, structures, terminologies, and structure–property relationships of polymeric materials.
2. Evaluate the relevance of polymeric materials in engineering applications and their role in sustainable solutions.

Unit 1: Fundamentals and Functional Properties of Polymeric Materials **[6 Hrs]**

1. Introduction and Classification of Polymers
2. Polymer Terminologies-Monomer, degree of polymerization, tacticity, copolymers, crosslinking, polymer backbone.
3. Properties of polymers-Solubility, Molecular Weight, Crystallinity, Glass transition temperature.
4. Life-cycle perspective: Applications, Environmental Impact, Sustainable Disposal

Unit 2: Advanced and Sustainable Polymer Systems in Engineering **[6 Hrs]**

1. Conducting polymers
2. Biodegradable polymers
3. Reinforced Plastics

Unit 3: Indian Knowledge System (IKS) Self-study: **[6 Hrs]**

1. Traditional Indian Knowledge in Polymeric materials and technology and the Role of Ancient Chemists.

Textbooks:

[1]	Gowariker, V. R., Viswanathan, N. V., & Sreedhar, J., *Polymer Science*, New Age International.
[2]	Billmeyer, F. W., *Textbook of Polymer Science*, Wiley.
[3]	Young, R. J., & Lovell, P. A., *Introduction to Polymers*, CRC Press.
[4]	Callister, W. D., *Materials Science and Engineering: An Introduction*, Wiley – Chapters on polymers.
[5]	Raman, V., & Chawla, S., *Plastics Technology Handbook*, Khanna Publishers.
[6]	Recent Articles from Polymer Engineering and Science and Journal of Applied Polymer Science.

Foundation of Quantum Physics						
Course Code	AS(BS)-25016		**Examination Scheme**			
Teaching Scheme	2-0-0-1		**CIE**	20		
Credits	1		**ESE**	30		

Course Outcomes: Students will be able to:

1. Derive and solve Schrödinger's time-dependent and time-independent wave equations for simple quantum systems.
2. Apply Schrödinger's equation to quantum systems such as free particles, particles in infinite, finite potential wells and harmonic oscillator.
3. Explain the phenomenon of quantum tunneling and its implications in microscopic systems.

Unit 1:	**Wave Mechanics**	**[7 Hrs]**

Matter waves, De-Broglie's concept of matter waves, Properties of matter waves, Heisenberg's uncertainty principle, Schrödinger's time dependent and time independent equations, Operators, Eigen values and Eigen functions, Expectation values, Physical significance of wave function.

Unit 2:	**Electrons in Potential Well**	**[7 Hrs]**

Applications of Schrödinger's equation; Motion of a free particle, Electron in an infinite deep potential well (rigid box), Electron in a finite deep potential well (non-rigid box), concept of quantum tunneling, Linear Harmonic oscillator

Unit 3:	**Indian Knowledge System (IKS) Self-study:**	

Concepts of Matter and Energy:

Ancient Indian texts regarding nature of matter and energy, offering perspectives that can be explored alongside modern physics theories.

Ancient Indian Astronomy:

The astronomical knowledge and models developed in ancient India including the celestial bodies, eclipses, and planetary movements, which can be compared with modern astronomical knowledge.

Textbooks:

[1]	Concepts of Modern Physics, Arthur Beiser; Tata McGraw – Hill Edition.
[2]	Modern Physics, Jeremy Bernstein, Paul M. Fish bane, Stephen Gasiorowics;
	Pearson Education.
[3]	Quantum Mechanics, L. J. Schiff; Mc-Graw Hill International Edition.

Basics of Civil Engineering					
Course Code	CE(ES)-25001	**Examination Scheme**			
Teaching Scheme	3-0-0-1	**MSE**	30	**CIE**	--
Credits	3	**CIE**	20		
		ESE	50		

Course Outcomes: students be able to:

1: Demonstrate different terminologies related to Civil Engineering.
2: Select suitable structural component or structure, services in a particular situation.
3: Apply the various concepts of environmental engineering in practice.
4: Assess suitability of material or type of foundation in a particular situation.

Unit 1 Introduction to Civil Engineering **[3Hrs]**

Role of Civil Engineer in the construction of buildings, dams, expressways and infrastructure projects for 21st century. Importance of an interdisciplinary approach in engineering. b) Basic Areas in Civil Engineering Surveying, Construction Engineering, Project Management, Transportation Engineering, Fluid Mechanics, Irrigation Engineering, Structural Engineering, Geotechnical and Foundation Engineering, Environmental Engineering, Quantity Surveying, Earthquake Engineering, Infrastructure Development, Town Planning, Remote Sensing.

Unit 2 Built Environment Planning **[3 Hrs]**

Concept of an integrated built environment-natural and manmade. Principles of planning, viz. Aspect, Prospect, Roominess, Grouping, Privacy, Circulation, Sanitation, Orientation, Economy. Role of by-laws in regulating the environment. b) Use of various eco-friendly materials in construction. Concept of green buildings.

Unit 3 Surveying **[4Hrs]**

Meaning and scope of surveying, importance in engineering Objectives of Surveying, Types of Surveying, basic surveying instruments and their uses, role of surveying in modern technology (GIS, GPS, drones).

Unit 4 Building material **[4Hrs]**

Types of buildings and classification as per occupancy and fire-resistance Components of buildings: Foundation, Walls, Floors, Roofs, Doors, Windows, Staircases, Finishes, Basics of building planning, orientation, ventilation, and lighting Green buildings and energy-efficient construction practices Classification and properties of common construction materials Stone, Brick, Timber, Cement, Lime, Concrete, Steel, Glass, Plastics, Bitumen, Selection of materials based on strength, durability, and sustainability, Introduction to advanced building materials: Fly ash, Geopolymer concrete, Recycled aggregates, Smart materials

UNIT 5 Advancements in Civil Engineering **[4Hrs]**

Structural marvels and their importance in human civilization, Historical and Modern Structural Wonders in Civil Engineering, Case Studies (Short videos/documentaries of construction marvels, Interdisciplinary nature of great structures (mechanical systems, electrical installations, material science, computing, etc.).

Text Books:

1. Arora S. P. and Bindra S.P., "Building Construction", Dhanpat Rai and Sons, Delhi.
2. Duggal S.K., "Surveying", Volume I, Tata Mc Graw Hill Publishing Company Limited New Delhi, Edition 2013

3.	Rajvir Singh, "Watershed Planning and Management", Yash Pulishing House, Jaipur, India 3rd Edition 2016
4.	Punmiya B.C., A.K.Jain and Ashok kumar Jain, "Soil Mechanics and Foundations", Laxmi Publications Pvt Ltd, New Delhi
5.	Shah, Kale and Patki, "Building Design and Drawing", Tata Mc Graw Hill, New Delhi
6.	Garg S.K. "Water Resources Engineering, Volume I", Khanna Publishers, New Delhi
7.	Garg S.K. "Water Resources Engineering, Volume II", Khanna Publishers, New Delhi
8.	Punmiya B.C., Ashok kumar Jain and A.K. Jain, "Water Supply Engineering", Laxmi Publications Pvt Ltd, New Delhi
9.	Punmiya B.C., Ashok kumar Jain and A.K. Jain, "Waste Water Engineering and Air Pollution", Laxmi Publications Pvt Ltd, New Delhi
Reference Books:	
1.	E.M. Tideman," Watershed Management: Guidelines for Indian Conditions", Omega Scientific Publishers.
2.	Sushil Kumar, "Building Construction", Standard Publishers Distributors, Nai Sarak Delhi

Fundamentals of Physical Infrastructure					
Course Code	CE(ES)-25002	**Examination Scheme**			
Teaching Scheme	3-0-0-1	**MSE**	30	**CIE**	--
Credits	3	**CIE**	20		
		ESE	50		

Course Outcomes: students will be able to:

1: Define and classify different types of infrastructure.
2: Explain the basic planning principles of transport, water, energy, and social infrastructure.
3: Explain the basic planning principles of transport, water, energy, and social infrastructure.
4: Discuss contemporary challenges and policies in infrastructure planning.
5: Appreciate sustainable and smart infrastructure practices.

Unit 1 Introduction to Infrastructure **[3 Hrs]**

- Definition, scope, and importance of infrastructure
- Classification: Economic vs. Social infrastructure
- Infrastructure and national development
- Overview of infrastructure scenario in India

Unit 2 Principles of Infrastructure Planning **[3 Hrs]**

- Basics of planning process
- Demand forecasting and capacity planning (introductory level)
- Life-cycle approach in infrastructure
- Cost, time, and quality considerations in infrastructure projects

Unit 3 Transportation Infrastructure **[4Hrs]**

- Road, rail, air, and water transport systems: significance and planning basics
- National and regional transportation planning
- Case examples: Highways, Metro systems, Logistics hubs

Unit 4 Water, Sanitation, and Waste Management Infrastructure **[4Hrs]**

- Water supply systems: sources, treatment, and distribution (overview)
- Sanitation systems and sewage management basics
- Solid waste management: collection, disposal, recycling
- Sustainable and decentralized solutions

UNIT 5 Energy and ICT Infrastructure **[4Hrs]**

- Power generation, transmission, and distribution (overview)
- Renewable energy (solar, wind, hydro, bioenergy)
- ICT infrastructure: broadband, digital platforms, e-governance
- Role of technology in infrastructure efficiency

UNIT 6 Sustainable and Smart Infrastructure **[6Hrs]**

- Environmental and social impacts of infrastructure projects
- Sustainable Development Goals (SDGs) and infrastructure linkages
- Smart cities: concepts and case studies in India
- Policy and mission initiatives: AMRUT, Bharatmala, PM Gati Shakti, Smart Cities Mission

Reference Books:

1. Grigg, N. S., Infrastructure Engineering and Management, Wiley.
2. Moser, M. A., Infrastructure Planning Handbook, McGraw Hill.
3. IRC / MoRTH / CPHEEO manuals (for practical exposure).
4. India Yearbook (latest edition, Infrastructure chapters).
5. Government portals (NITI Aayog, MoHUA, MoRTH, Ministry of Power)

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AI for Multidisciplinary Applications *Offered to students of other departments*						
Course Code	CT(ES)-25001		**Examination Scheme**			
Teaching Scheme	3-0-0-1		**MSE**	30		
Credits	3		**CIE**	20		

Course Outcomes: Students will be able to:

1. Understand the fundamentals of Artificial Intelligence and its evolution.
2. Use AI techniques for problem-solving and searching in simple domains.
3. Apply basic NLP techniques using Word2Vec and BERT for text analysis.
4. Implement generative AI for text generation and fine-tuning.
5. Utilize AI tools and prompt engineering for effective applications.
6. Analyze real-world case studies of AI applications in various engineering domains.

Unit 1: Foundations of AI **[3 Hrs]**

The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Models, Agents & Agentic AI, Types of AI, Applications, AI Ethics and AI for Social Good.

Unit 2: Introduction to AI concepts **[3 Hrs]**

Model training, and Model Inferencing, Problem Solving by Searching, Introduction to Supervised and Unsupervised learning, Basics of Neural Networks, Types of Neural Networks, Multi-modality.

Unit 3: Natural Language Processing **[4 Hrs]**

Intro to text processing, Intro to Word Embeddings like Word2Vec, Basic Intro to BERT transformer model

Unit 4: Generative AI **[4 Hrs]**

Introduction to Gen AI, Gen AI Evolution, Text/Image/Music generation, Training, Prompting and Fine-tuning, Hugging Face and Ollama.

Unit 5: AI Tools and Prompt Engineering **[4 Hrs]**

Tools in the Industry, Types of AI tools, Components of a prompt, Types of prompts, Applications of Prompt Engineering.

Unit 6: Case Studies (Self Study) **[6Hrs]**

Structural Health Monitoring, Flood Prediction, Predictive Maintenance, Robotics and Automation, Energy Management

Textbooks:

[1] Russell, S. & Norvig, P. (2020), Artificial Intelligence: A Modern Approach, 4th Ed. Pearson.

[2] Perry Xiao (2022), Artificial Intelligence Programming with Python, First Edition, Wiley.

Reference Books:

[1] David L. Poole, Alan K. Mackworth, “Artificial Intelligence: Foundations of Computational Agents”, Third Edition, 2023, Cambridge University Press.

[2] Sutton, R. S., & Barto, A. G. (2018). Reinforcement Learning: An Introduction. (2nd ed.). A Bradford Book.

Web Resources:

[1]	Stanford Course webpage: https://stanford-cs221.github.io/spring2024/
[2]	Barckley Course webpage: https://inst.eecs.berkeley.edu/~cs188/su25/
[3]	MIT Course web page: https://ocw.mit.edu/courses/6-034-artificial-intelligence-fall-2010/pages/syllabus/
[4]	NPTL Course webpage: https://nptel.ac.in/courses/106102220
[5]	Coursera: Andrew Ng's courses on Machine Learning and Deep Learning: https://www.coursera.org/specializations/machine-learning-introduction
[6]	Papers with Code: A repository of academic papers with corresponding code implementations: https://paperswithcode.com/
[7]	TensorFlow Official Website: Excellent documentation and tutorials for the leading Deep learning framework: https://www.tensorflow.org/
[8]	PyTorch Official Website: Excellent documentation and tutorials for the leading deep learning framework: https://pytorch.org/
[9]	Google AI: Research and education resources from Google's AI team: https://cloud.google.com/ai

Applied Electronics and IoT (offered by E&TC Department to other branches)						
Course Code	CT(ES)-25001		**Examination Scheme**			
Teaching Scheme	3-0-0-1		**MSE**	30		
Credits	3		**CIE**	20		
			ESE	50		

Course Outcomes: At the end of the course, students will demonstrate the ability to

1. Explain the working of semiconductor devices and simple circuits. (BL2)
2. Apply op-amp and digital concepts in control and automation. (BL3)
3. Describe the fundamentals of communication systems and associated protocols. (BL2)
4. Relate electronics principles to real-world multidisciplinary applications. (BL4)
5. Demonstrate awareness of IoT, communication protocols, and emerging technologies across disciplines. (BL2, BL3)

Unit 1 Diodes and Applications: **(7hrs)**

PN junction diode: working principle and characteristics. Rectifiers: half-wave, full-wave, and role of filters. Zener diode as voltage regulator. LED, photodiode, solar cell – working & applications.
Applications/Case Studies: Solar lighting in smart cities, Optical sensors in robotics, Photodiode in material inspection, Rectifiers in power supplies, LEDs in displays.

Unit 2 Transistor Circuits and IC 555 Applications: **(7hrs)**

BJT basics, concept of amplification & switching. CE amplifier (qualitative). IC 555 timer basics (a stable, monostable) – simple applications. Applications/Case Studies: Vibration sensing in condition monitoring, Amplifiers in CNC control, Ultrasonic NDT equipment, Amplifiers in measurement systems.

Unit 3 Operational Amplifiers and Applications: **(6hrs)**

Op-amp as a building block, inverting & non-inverting amplifiers, comparator, summing amplifier.
Applications/Case Studies: Signal conditioning for structural health monitoring, Process control & robotics, Data acquisition systems, Analog-to-digital interface.

Unit 4 Digital Electronics Fundamentals: **(7hrs)**

Number systems, logic gates, truth tables. Boolean simplification (qualitative). Combinational circuits: adder, multiplexer. Flip-flop applications (timers, counters).
Applications/Case Studies: Automated traffic light control, Counters in robotic arms, ALU basics, Logic in protective relays.

Unit 5 Communication Systems and Protocols: **(7hrs)**

Block diagram of a basic communication system. Wired vs wireless communication. Basics of AM & FM (concept only). IoT Communication Protocols (overview): Wired - RS-232, Modbus, CAN bus. Wireless - Wi-Fi, Bluetooth, Zigbee, LoRa. Application layer - MQTT, HTTP (IoT cloud).
Applications/Case Studies: LoRa for smart cities. CAN bus in automotive systems. Modbus in factory automation. Zigbee in smart grids. MQTT in SCADA.

Unit 6 Microcontrollers, IoT, and Emerging Trends: **(8 hrs)**

Microcontroller – Overview (block diagram, role in automation). IoT concepts – architecture, sensors, connectivity, cloud. Emerging technologies: 5G/6G, Industry 4.0, wearable electronics, satellite communication for surveying and smart infrastructure.
Applications/Case Studies: IoT-based predictive maintenance (focused on machine health), Smart process monitoring (focused on process parameters), Smart grids & renewable energy monitoring, IoT-enabled process control (focused on automated, remote control).

Textbooks:
• Malvino, A.P., and Bates, D.J. Electronic Principles, McGraw Hill Education, 7th Edition, 2017. • Floyd, T.L. Electronic Devices, Pearson Education, 9th Edition, 2012. • Jain, R.P. Modern Digital Electronics, McGraw Hill Education, 4th Edition, 2010. • Frenzel, L.E. Principles of Electronic Communication Systems, McGraw Hill Education, 3rd Edition, 2012.
Reference Books:
• Sedra, A.S., and Smith, K.C. Microelectronic Circuits, Oxford University Press, 7th Edition, 2014. • Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Pearson Education, 4th Edition, 2001. • Mazidi, M.A., Mazidi, J.G., and McKinlay, R.D. The 8051 Microcontroller and Embedded Systems, Pearson Education, 2nd Edition, 2006. • Anand Kumar, A. Fundamentals of Digital Circuits, PHI Learning, 4th Edition, 2016.

ES2: Electrical Energy Utilization

Offered to students of other departments

Course Code	EE(ES)-25001		**Examination Scheme**			
Teaching Scheme	3-0-0-1		**MSE**	30		
Credits	3		**CIE**	20		
			ESE	50		

Course Outcomes: Students will be able to:

1. Analyze the fundamentals of electrical energy systems
2. Evaluate energy utilization patterns across Residential, Commercial, Industrial Sector
3. Apply principles of illumination to design efficient lighting systems
4. Explain and apply electric heating and welding techniques
5. Explain the concept and requirements of an ideal electric traction system.
6. Apply knowledge of electrical safety measures, earthing systems, earth wires, and safety practices to ensure safe operation

Unit 1: Fundamentals of Electrical Energy Systems: **[3 Hrs]**

Introduction to AC and DC supply, Comparison of AC vs DC supply systems, Passive components(R, L,C), RMS, Average values, Form factor, Power factor, real and reactive power, apparent power, star & delta connections, Applications, Electrical tariff for residential, commercial and industrial consumers, HT tariff and LT tariff.

Unit 2: Residential, Commercial, and Industrial Sector Energy Utilization: **[3 Hrs]**

Introduction to Energy Consumption, Energy Utilization in Residential, Commercial, Industrial Sector like DC motor and Induction motors, Comparative Analysis Across Sectors, HVAC, Industrial Motors, Servers in IT sector, UPS, DGs, Inverters, Elevators, Household fan, coolers, EVs, Traction loads, Driving Factors Behind Energy Use, Strategies for Energy Conservation.

Unit 3: Principles of Illumination and Lighting Technology: **[4 Hrs]**

Nature of light, LED lamps, Smart lighting systems and their controls, various terms relating to illumination. Lighting schemes and their requirements. Design of lighting schemes, Energy-efficient lighting practices.

Unit 4: Electric Heating and Welding: **[4 Hrs]**

Methods of transferring the heat. Methods of resistance heating. Resistance furnaces. Characteristics of induction heating. Induction furnaces. Dielectric heating. Arc furnace. Power supply and control of furnaces. Electric welding.

Unit 5: Electric Traction: **[4 Hrs]**

Introduction of electric traction system, Requirements of ideal traction system, System of Track Electrification: DC; Single phase 25kV AC, Composite system, Traction Mechanics: Block diagram of AC electric locomotive and function of each part, Nomenclature of Locomotive, Crest, Average and Schedule Speed; definition and factors affecting them. Traction services: Urban, suburban, main line service, Speed Time curve, Concept and applications of Trapezoidal and quadrilateral speed time curve.

Unit 6: Electrical Earthing and Safety: **[6 Hrs]**

Types of wires and cables, Copper conductor sizes and rating, Switch Fuse Unit (SFU), Miniature Circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB), Lightning protection. Types and characteristics of Batteries, elementary calculations for energy consumption, and battery backup, Electrical safety: Electrical safety measures, safety practices, Earthing, , earth wires, first aid treatment after electrical shock.

Textbooks:

[1]	C. L. Wadhwa, Generation, Distribution and Utilization of Electrical Energy, New Age International Publishers, 2017.
[2]	J. B. Gupta, Utilization of Electric Power and Electric Traction, S.K. Kataria & Sons, 2022.
[3]	S. L. Uppal and G. C. Garg, Electrical Wiring Estimating & Costing, Khanna Publishers, 6th edition ,2025.
[4]	H. Pratap, Art and Science of Utilization of Electrical Energy, Dhanpat Rai & Sons, 2016 edition.
[5]	Randy Barnett, Commercial and Industrial Wiring, ATP (American Technical Publishers), 2nd Edition, 2013
Reference Books:	
[1]	B. L. Theraja and A. K. Theraja, A Textbook of Electrical Technology, Vol. II (AC & DC Machines, Utilization & Electrical Engineering), S. Chand & Company Ltd., **24th edition**,2024.
[2]	S. C. Tripathy, Electrical Power Utilization, McGraw Hill Education, 1991.
[3]	Wayne C. Turner and Steve Doty, Energy Management Handbook, 8th Edition, Fairmont Press, 9th edition,2018.
[4]	Donald Beeman, Industrial and Commercial Power Systems Handbook, McGraw Hill Education, 1955.
Web Resources:	
[1]	NPTEL online course, Basic Electrical Technology – IIT Kharagpur https://nptel.ac.in/courses/108/102/108102146/
[2]	Energy.gov, *Commercial and Residential Energy Efficiency Resources* https://www.energy.gov/
[3]	NPTEL online course, *Illumination Engineering* – IIT Madras https://nptel.ac.in/
[4]	National Digital Library of India (NDLI), *Electrical Safety and Installation Resources* https://ndl.iitkgp.ac.in/ Electrical Engineering Portal, *Earthing and Grounding Systems* https://electrical-engineering-portal.com/ https://cloud.google.com/ai

Fundamentals of Measurement and Sensors					
Course Code	ICE(ES)-25001	**Examination Scheme**			
Teaching Scheme	3-0-0-1	**MSE**	30		
Credits	3	**CIE**	20		
		ESE	50		

Course Outcomes: At the end of the course, students will demonstrate the ability to

1. List different types of sensor/measuring instruments used for displacement, velocity, acceleration, force and torque.
2. To introduce measuring instrument and implement resistance, capacitance and inductance measurement system.
3. Define and describe working principles and characteristics of the sensors and Measuring Instruments.
4. Select and defend suitable sensor/measuring system for a specific application

Unit 1: Introduction of measuring Systems: **6 Hrs**

Concepts and terminology of measurement system, transducer, sensor, range and span, classification of transducers, static and dynamic characteristics, selection criteria, sources of errors and their statistical analysis, standards and calibration.

Unit 2: Resistance, Inductance & Capacitance Measurement: **8 Hrs**

Wheatstone bridge, Kelvin Bridge, Maxwell's bridge, Hay's bridge, Schering bridge: design and applications.

Unit 3: Measuring Instruments: **6 Hrs**

Oscilloscope: Introduction, various parts, front panel controls, use of CRO for measurement of voltage, current, period, frequency. Phase angle & frequency by Lissajous pattern. Introduction to DSO, DMM.

Unit 4: Displacement Measurement **8 Hrs**

Linear and rotary type Potentiometer, Strain gauge, LVDT, RVDT, Eddy current type Transducers, Capacitive, Optical transducers, Hall effect transducers.

Unit 5 Velocity and Acceleration Measurement: **6 Hrs**

Moving magnet and moving coil, tachometers and its types. Accelerometer: Potentiometric, LVDT, Piezo-electric type

Unit 6 Force and torque measurement: **6 Hrs**

Basic methods of force measurement, elastic force traducers, strain gauge, load cells, piezoelectric force transducers, Strain gauge torque meter, Inductive torque meter, Magneto- strictive transducers, torsion bar dynamometer.

Textbooks:

- A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", DhanpatRai and Sons, 12th ed., 2005
- B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, 4th ed., 2016

Reference Books:

- E.O. Doebelin, "Measurement Systems", McGraw Hill, 6th ed., 2017
- D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, 2nd ed., 1999
- A. J. Bouwens, "Digital Instrumentation", McGraw-Hill, 6th reprint, 2008
- H S Kalsi, "Electronic Instrumentation", Tata McGraw-Hill, 4th ed., 2017
- Albert D. Helfrick, William David Cooper, "Modern electronic Instrumentation and Measurement Techniques" Prentice Hall, Second ed., 1990

Foundations in Mechanical Engineering					
Course Code	ME(ES)-25001	**Examination Scheme**			
Teaching Scheme	3-0-0-1	**MSE**	30		
Credits	03	**CIE**	20		
		ESE	50		

Course Outcomes: Student will be able to

1. Acquire basic knowledge about laws of Thermodynamics and apply them in energy conversion devices.
2. Learn about the basic concept, modes of heat transfer and apply in heat exchanger devices.
3. Learn the basics of power transmission elements and machine tools , their applications and apply that knowledge in real time industry scenario.
4. Observe various elements of power transmission, understand their suitability for various industrial power transmitting applications.
5. Develop understanding about the role and need of renewable energy sources.

Unit 01. Introduction to Thermodynamics — **03 Hrs**

Basic Concepts: Thermodynamic system, Equilibrium etc. Thermodynamic work and Heat, I and II Laws of thermodynamics and their applications in Engineering, Heat Engine, Refrigerator and Heat pump, Carnot Principle.

Unit 02. Energy Conversion Devices — **03 Hrs**

Introduction to Steam turbine, Gas turbine, Hydraulic turbines, Two Stroke and Four stroke I.C. engines (Petrol and Diesel), Reciprocating Compressor, Reciprocating and Centrifugal pump, (Elementary treatment only), Vapour Compression Refrigeration Cycle, Study of household refrigerator.

Unit 03. Heat Transfer — **03 Hrs**

Statement and explanation of Fourier's law of heat conduction, Heat conduction in plane wall, Composite slab, Composite hollow cylinder (no derivation), Electrical analogy, Concept of thermal resistance, Overall heat transfer coefficient, Newton's law of cooling, Stefan-Boltzman's law (Elementary Numericals), Concept of heat exchanger, types and concept of effectiveness

Unit 04 Machine elements — **03 Hrs**

Power transmission shafts, axles, keys (types and constructional features), Bearings: Purpose, Classification, sliding contact bearing: Solid journal bearing, Bush bearing, Rolling contact bearing: Ball bearing, Roller bearing. Power Transmission Devices (basic elements, constructional features): Belt drive: Flat and V belt drive, Open and Cross belt drive, Chain drive, Gear drives: Spur gear, Helical Gear, Spiral Gear, Bevel Gear, Worm and Worm Wheel, Rack and Pinion, Couplings: Rigid Coupling: Muff coupling, Flange Coupling, Flexible Coupling: Universal Coupling.

Unit 05 Introduction to Manufacturing — **03 Hrs**

Machine tools: Lathe machine, Drilling Machine, milling machine (Basic elements, Working Principle and operations). Manufacturing processes: Casting: Pattern making, Moulding, Forging, and metal joining processes: Welding, Soldering, Brazing.

Unit 06 Non-conventional Energy Sources — **03 Hrs**

Concept of Conventional and non-conventional energy, Harnessing of Non-conventional energy source, Solar energy: Flat Plate Collector, Binary cycle solar thermal power plant, Wind turbine, Geothermal Power plant, Ocean thermal energy converter (OTEC), Fixed dome type biogas plant, Hydroelectric power plant, Nuclear reactor power plant. (construction and working)

Nanomaterials					
Course Code	MM(FS)-25001	**Examination Scheme**			
Teaching Scheme	3-0-0-1	**MSE**	30		
Credits	3	**CIE**	20		
		ESE	50		

Course Outcome: Student will be able to

1.Explain the basic principles of nanoscience, quantum confinement, and size-dependent material properties.
2.Describe various synthesis routes (top-down and bottom-up) for nanomaterials.
3. Identify and apply different characterization techniques (microscopy, spectroscopy, diffraction) for nanostructures.
3.Analyse the applications of nanomaterials in metallurgy, energy, environment, healthcare, and electronics.
4.Evaluate the ethical, environmental, and societal impacts of nanotechnology innovations.

Unit 01. Introduction to Nanomaterials: Introduction: **03 Hrs**

History and scope of nanomaterials: bionanomaterials, magnetic nanomaterials etc, Surface energy, defects, and stability of nanoparticles.

Unit 02. Fundamentals of Nanoscience: **03 Hrs**

Size and dimensionality (0D, 1D, 2D, 3D nanostructures), Quantum mechanics for nanomaterials, Quantum confinement and size-dependent properties, Quantum tunnelling, Density of states

Unit 03. EE: **03 Hrs**

Top-down approaches: Mechanical milling, lithography, etching, Bottom-up approaches: Sol–gel, chemical vapor deposition (CVD), self-assembly, green synthesis and sustainable approaches.

Unit 04. Characterization Techniques: **03 Hrs**

Electron microscopy (SEM, TEM, AFM), Spectroscopy (XRD, UV-Vis, FTIR, Raman), Thermal methods (DSC, TGA for nanoscale materials).

Unit 05. Applications of Nanomaterials: Metallurgy: **03 Hrs**

Nanostructured steels, coatings, composites, Energy: Batteries, supercapacitors, solar cells, hydrogen storage, Environment: Water purification, sensors, catalysis, Healthcare: Drug delivery, imaging, implants, Electronics: Nanoelectronics, MEMS/NEMS, Other applications in various branches of engineering

Unit 06 Ethics, Safety, and Societal Impact: **03 Hrs**

Nanotoxicology and safety protocols, Environmental sustainability and circular economy in nanomaterials, Ethical issues and regulatory frameworks, Future trends: AI in nanotechnology, Industry 4.0 applications

Reference Book:

Lindsay, Stuart. *Introduction to nanoscience*. American Chemical Society, 2010.

Rajendra Kumar Goyal," Nanomaterials and nanocomposites: Synthesis, Properties, Characterization Techniques and Applications" CRC Press, 2017, ISBN: 978-14987616662017.

B.S. Murty, P. Shankar, Baldev Raj, B B Rath, James Murday, "Textbook of

Nanoscience and Nanotechnology", 2013, University Press (I) Pvt. Ltd. (e-ISBN:978-3-642-28030

Basics of Manufacturing Technology					
Course Code	MFG(ES)-25001	**Examination Scheme**			
Teaching Scheme	3-0-0-1	**CIE**	20		
Credits	3	**MSE**	30		
		ESE	50		

Course Outcome: Student will be able to

1. To provide fundamental knowledge of various basic manufacturing processes.
2. To understand principles of various basic manufacturing processes.
3. To know the process variables associated with various basic manufacturing processes.
4. To become aware about manufacturing processes associated with various engineering materials.

Unit 01. Casting and Forming Processes	**03 Hrs**
Pattern Making and casting: Introduction, Pattern materials, pattern making tools, Types of patterns, Core boxes, Molding tools and equipment. Introduction to Sand casting processes and equipment's, various types of casting Processes. Mechanical working of metals: Introduction, Hot working, Hot rolling, seamless tubing, Drawing, Deep Drawing, Hot spinning, Extrusion, Cold-working, Cold-rolling, Cold-drawing, Cold-bending, Cold-spinning, Cold-extrusion, Squeezing, Peening.	
Unit 02. Conventional Machining Processes	**03 Hrs**
Introduction of material removal processes; chip removal processes: turning, milling, drilling, shaping, broaching, gear cutting; abrasion processes: polishing, grinding, honing, and lapping.	
Unit 03. Joining Processes	**03 Hrs**
Introduction of joining processes; fusion welding processes: gas welding, arc welding, resistance welding, high energy beam welding processes. solid-state welding processes, solid-liquid state welding: brazing, soldering; adhesive bonding; mechanical fastening	
Part II	
Unit 04. a) Sheet Metal Working	**2 Hrs**
Sheet metal properties, gauge and surface condition, Study of process and equipment used, various cutting and forming operations. Blanking and Punching: Theory, types of die used, force requirement, theory of shear. Deep drawing: types of dies used, defects.	
b) PCB Artwork and Surface Treatment	**1 Hrs**
Etching, anodizing and electroplating etc., Classification, types and applications of adhesives.	
05 Introduction to NC/CNC Machines and Robotics	**03 Hrs**
a) NC/CNC Machines: Principle, classification, construction and applications. b) Robots: Principle, classification, construction, control systems and applications.	
06 Measurement Systems	**03 Hrs**
Limits, fits and surface quality: Introduction, Interchangeability, Elements of interchangeable system, Fits, allowances, clearances and interferences, Types of fits, Hole basis and shaft basis, Geometric dimensioning and tolerances, Limit systems, The Indian Standard system, Selective assembly, Surface finish Measurement and inspection: Introduction, Standards of measurement, Classification of measuring instruments, Linear measurement, Comparators, Measuring machines, Angular measurement.	
Textbooks:	

1. Hajra Chaudhary S.K.- Elements of Workshop Technology, Vol. I& II, Media Prom & Pub, Mumbai.
2. Rao P.N.: Manufacturing Technology, Vol I, II, Tata McGraw Hill.
3. Chapman W.A.J.: Workshop Technology, Volume I, II, III; ELBS
4. Hajara Chaudhary, Bose S.K.: Elements of workshop Technology, Volume I, II, Asia Publishing
5. House.
6. Jain R.K.: Engineering Metrology, Khanna Publisher, Delhi

References:

1. HMT: Production Technology, TMH Publishing Co., New Delhi, 1985.
2. Roy A. Lindberg: Processes and Materials of Manufacture, fourth Edition, Prentice Hall of India, New Delhi, 1990.
3. Campbell J.S. : Principles of manufacturing Materials and Processes, McGraw-Hill, New York
4. I.C. Gupta: Metrology and Quality control – 5th Edition, Dhanapat Rai Publications, New Delhi.

Applied Mechanics					
Course Code	CE(ES)-25003	**Examination Scheme**			
Teaching Scheme	2-0-2-1	**MSE**	30	**CIE**	100
Credits	3	CIE	20		
		ESE	50		

Course Outcomes: Students will be able to:

1. Apply laws of statics to determine resultants and equilibrium conditions of 2D/3D concurrent force systems.
2. Analyse simple structures (beams, trusses, cables) and solve problems involving dry friction and belt drives.
3. Solve kinematics problems of particles in rectilinear and curvilinear motion using different coordinate systems.
4. Apply Newton's laws, Work–Energy, and Impulse–Momentum principles to simple dynamic systems including central impact.

Unit 1: Concurrent Force system **[3 Hrs]**

Forces, Free-Body Diagrams, Resultant and Equilibrium of Two-dimensional and Three- dimensional concurrent force System (2D and 3D), Moment vector, Couples, Equivalent Force systems

Unit 2: Structures in Equilibrium **[3 Hrs]**

Beams, Trusses, Cables, Dry Friction for inclined planes, Belt friction

Unit 3: Motion of a Point **[3 Hrs]**

Position, Velocity and Acceleration, Straight Line motion, Curvilinear Motion, Cartesian coordinates, normal & tangential coordinates and polar coordinates. Relative motion

Unit 4: Forces, Mass and Acceleration **[3 Hrs]**

Newton's second law, Work-Energy Principle, Impulse-Momentum Principle, Direct central impact

Textbooks:

[1] Hibbeler R. C., "Engineering Mechanics - Statics", 14th Edition Prentice Hall

[2] Hibbeler R. C., "Engineering Mechanics - Dynamics", 14th Edition, Prentice Hall

[3] Beer F. P., Johnston E. R. et al., "Vector Mechanics for Engineers:] Statics Dynamics", 12th Edition, McGraw-Hill Publication

Reference Books:

[1] Meriam J. L., Kraige L. G., "Engineering Mechanics - Statics", John Wiley and Sons, 8th Edition

[2] Meriam J. L., Kraige L. G., "Engineering Mechanics - Dynamics", John Wiley and Sons, 8th Edition

[3] Bedford and W. Fowler, "Engineering Mechanics - Statics and Dynamics", Pearson Publications

Part A Lab Experiments (any six):

1. Verification of law of polygon of forces
2. Verification of law of moments
3. Study of Space force system
4. Determination of beam reactions
5. Belt friction
6. Determination of shear force and bending moment of beam
7. Verification of Newton's second law of motion
8. Curvilinear motion
9. Direct central impact

Part B Assignments: Each assignment shall have minimum two problems.

	1. Determination of resultant for parallel and non-concurrent force system -Analytical and graphical method. 2. Determination of resultant for parallel and non-concurrent force system – using computer program. 3. To find beam reactions of simply supported beam with inclined and vertical load-Analytical, graphical method 4. To find beam reactions of simply supported beam with inclined and vertical load-- using computer program. 5. Find the member forces in truss -Analytical and Computer based solution. 6. To draw motion curves (s-t, v-t, a-t Diagram) - Analytical and Graphical method

Fundamentals of Cyber Security *Offered to students of other departments*						
Course Code	CT(ES)-25002		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**MSE**	30	**CIE**	100
Credits	3		**CIE**	20		
			ESE	50		

Course Outcomes: Students will be able to:

1.Explain the basic concepts of cyberspace, cybersecurity, and types of cybercrimes.
2.Understand basic networking concepts, common protocols, and online communication systems.
3.Identify common cyber threats and apply simple safe online practices and protection tools.
4.Describe key aspects of cyber laws, privacy, cyber ethics, and responsible online behaviour.

Unit 1: Introduction to Cybersecurity **[4 Hrs]**

Introduction to Cyberspace, World wide web, Need for Cybersecurity, Cyber Crime: Definition and origin of the term: Cyber Crime and Information Security, Cybercriminals, CIA triad (Confidentiality, Integrity, Availability), Classification of Cyber Crimes, Issues and challenges of cyber security.
Self-Learning Topic: Types and Classification of Cybercrimes with Case Studies in India

Unit 2: Basics of Computer Networking **[4Hrs]**

Basic Networking Concepts: Internet, Intranet, IP Addressing (IPv4) & Port Numbers (TCP), DNS, Email, Structure of Websites with multiple hyperlinks, Common network devices (routers, switches and firewalls), Basic Protocols: HTTP, Snooping HTTP traffic, HTTPS to secure web traffic
Self-Learning Topic: Explore "How the Internet Works".

Unit 3: Cyber Threats and Online Safety **[5 Hrs]**

Introduction to Cyber Threats, Common Threats in Everyday Life (Viruses, Phishing, Identity Theft, Social Engineering), Safe Online Practices (Avoid unknown links, use strong and different passwords, keep devices and apps updated, be careful while sharing personal information online), Basic Protection Tools (Antivirus, Password Managers, Two-Factor Authentication (2FA) – Conceptual Awareness).
Self-Learning Topic: Learn about a simple online scam (like a fake message or email) and understand easy steps to stay safe

Unit 4: Cyber Laws, Ethics, and Privacy **[5 Hrs]**

Overview of IT Act 2000 (Key Points Only), Intellectual Property, Privacy, and Data Protection, Cyber Ethics, Responsible Online Behaviour, Safe Use of Social Media, Password Hygiene, and Personal Data Protection Practices.
Self-Learning Topic: Learn about a simple cybercrime case in India (like online banking fraud or social media scam) and understand easy steps to stay safe online.

Textbooks:

[1]	Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes,Computer Forensics and Legal Perspectives,Wiley
[2]	V. K. Pachghare, "Cryptography and Information Security", 3rd edition, PHI Learning, ISBN: 978-93-893-4710-4.

Reference Books:

[1]	Graham, J., Howard, R., & Otson, R. (2010). Cyber security essentials. CRC Press.
[2]	Wu, C.-H., & Irwin, J. D. (2013). Introduction to cyber security. CRC Press, Taylor & Francis Group.

Web Resources: National Cyber Crime Reporting Portal (India):

https://cybercrime.gov.in
Stay Safe Online (Ministry of Electronics & IT, Govt. of India):
https://www.staysafeonline.in
Information Security Education and Awareness (ISEA)
InfoSec awareness initiative:
https://infosecawareness.in/
Cisco Networking Academy – Introduction to Cybersecurity
https://www.netacad.com/courses/cybersecurity/introduction-cybersecurity
Khan Academy – Internet 101 (Encryption, Networks & Security Basics)
https://www.khanacademy.org/computing/computer-science/internet-intro
INTRODUCTION TO CYBER SECURITY (SWAYAM / NPTEL)
A basic course on cyber security for undergraduate level:
https://onlinecourses.swayam2.ac.in/nou19_cs08/preview
Coursera – Introduction to Cyber Security Specialization (NYU)
https://www.coursera.org/specializations/intro-cyber-security
Khan Academy – Computers & the Internet / Internet topics
https://www.khanacademy.org/computing/computers-and-internet

List of Experiments/Assignments:

[1] Case Study: A recent cybercrime incident in India (e.g., online banking fraud) and present the type of crime and its impact.

[2] Simple Email and Web Investigation: Identify the structure of an email (To, From, Subject) and explore basic website details (URL, HTTP/HTTPS).

[3] Explore Device Settings: Check basic system information like IP address, Wi-Fi status, and connected devices.

[4] Device Safety: Demonstration of antivirus scanning, software update, and enabling Two-Factor Authentication (2FA) on a simple app.

[5] Create 3 passwords (weak, medium, strong), test them and understand how password complexity affects security.

[6] Safe Internet Practices: Explore actions online that may compromise privacy, such as clicking unknown links or oversharing personal information.

[7] Perform basic network commands (ipconfig, ping, hostname, ping google.com etc.)

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[5] Create 3 passwords (weak, medium, strong), test them and understand how password complexity affects security.

[6] Safe Internet Practices: Explore actions online that may compromise privacy, such as clicking unknown links or oversharing personal information.

[7] Perform basic network commands (ipconfig, ping, hostname, ping google.com etc.)

[8] Use Wireshark to capture network packets and observe the difference between a message sent without encryption (plain text) and with encryption (protected).

[ES-01] Basic Electrical Engineering
Offered to students of other departments

Course Code	EE(ES)-25002		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**MSE**	30	**CIE**	100
Credits	3		**CIE**	20		
			ESE	50		

Course Outcomes: Students will be able to:

1. At the end of the course, students will demonstrate the ability to
2. Analyse AC and DC circuits
3. Apply the principles of electric and magnetic circuits to solve engineering problems
4. compute the efficiency and regulation of a single-phase transformer
5. select motors for specific industrial applications
6. **use relevant protective devices for electrical installations measure various quantities by using common electrical measuring instruments**

Unit 1: Fundamentals of Electric Circuits: **[4 Hrs]**

Review of fundamental circuit laws, Mesh and Nodal analysis. Analysis of simple DC circuits: Superposition, Thevenin and Norton theorems, Maximum Power Transfer theorem, Star-Delta transformation

Unit 2: AC Circuits **(4Hrs)**

Representation of sinusoidal waveforms, peak, average, rms values, phasor representation, real power, reactive power, apparent power, power factor, peak factor, and form factor, phase difference, lagging, leading and in phase quantities. Analysis of single-phase ac circuits consisting of R, L, C, combinations, series resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections, three-phase power, concept of electric grid, Tariffs

Unit3: Magnetic Circuits and Transformers: **(4 hrs)**

Magnetic materials, B-H curve, hysteresis loop, series and parallel magnetic circuits, ideal and practical transformer, equivalent circuit, losses in transformers, regulation, and efficiency. Autotransformer and three-phase transformer connections

Unit4: Rotating Electrical Machines: **(3 hrs)**

Construction, working principle, types, characteristics and applications of DC motors and three-phase induction motors (torque-speed characteristic, simple problems based on formulae)

Unit5: Electrical Wiring and Safety: **(3 hrs)**

Types of wires and cables, Copper conductor sizes and rating, earth wires, Switch Fuse Unit (SFU), Miniature Circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB), Lightning protection. Types and characteristics of Batteries, elementary calculations for energy consumption, and battery backup, inverter, UPS types and specifications

Electrical safety: Electrical safety measures, safety practices, Earthing and its importance, first aid treatment after electrical shock

Textbooks:

1) D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2nd Edition 2019
2) D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 4th Edition, 2019
3) E. Hughes, “Electrical and Electronics Technology”, Pearson, 10th Edition, 2010

Reference Books:

- Vincent Del Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 2nd Edition, 2015.
- L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2nd Edition, 2003.

Basic Electrical Engineering: Laboratory *Offered to all students*
Experiments:
1. Overview of the Basic Electrical Engineering Lab (Equipment available: universal trolley, meters, transformers, loads, etc.) and safety precautions. 2. Verification of Network Theorems: 3. Connect a simple DC circuit with two loops and more than one source and measure all the branch currents and node voltages. 4. Solve the same circuit applying Thevenin's, Norton's, and Superposition Theorems. 5. Measure the voltage, current, and power in the R-L, R-C, and R-L-C series circuits and observe the phase difference between voltage and current using CRO. 6. Connect the three-phase induction motor in star and delta and measure the line and phase voltages and currents to verify the relationship between line and phase quantities. 7. Evaluation of Relative permeability and Magnetic reluctance of a 3-Limb core using an exciting coil of unknown number of turns. 8. Flux diversion in the 3-Limb core by generating circulating currents in short-circuited conductor loop placed around the central limb. 9. Determine the efficiency and regulation of a single-phase transformer by direct loading. 10. Starting, reversing and speed control of DC motor. 11. Starting and reversing of three-phase induction motor and measurement of slip at different load conditions. 12. Connect the single-phase load bank through a switch-fuse unit, MCB and ELCB and check their operation in case of overload, short circuit, and earth leakage.

Digital Logic Design (Theory + Lab)

Course Code			**Examination Scheme**			
Teaching Scheme	2-0-2-1		**MSE**	30	**CIE**	100
Credits	3		**CIE**	20		
			ESE	50		

Course Outcomes: Students will be able to:

1. Simplify Boolean functions and realize the same using logic gates. (BL2)
2. Represent numbers in various formats and convert them from one system to another. (BL1)
3. Design combinational logic circuits. (BL3)
4. Design sequential logic circuits. (BL3)
5. Analyze combinational and/or sequential systems. (BL4)

Unit 1: Introduction to Boolean Algebra and Logic Circuits: **(8 hrs)**

Basic logic gates, universal gates, SOP and POS forms, simplification of logic functions using Boolean algebra, realizing logic functions using logic gates, K-maps (up to 4 variables), Number representations and conversions.

Unit 2: Combinational Logic Circuits: **(6 hrs)**

Definition, design of half and full adder/subtractor, code converters, multiplexers, decoders, BCD adder (IC 74LS83), magnitude comparator (IC 74LS85).
Application: Multiplexed digital communication channel.

Unit 3: Sequential Logic Circuits: **(8 hrs)**

Definition, latch, flip-flops, types of flip-flops (SR, JK, T, D), flip-flop conversion, asynchronous and synchronous counter design using flip-flops, random sequence generator, design problems.
Application: Traffic light indicator, home automation controller.

Unit 4: Application-Specific Counter ICs: **(6 hrs)**

Decade counter IC 74LS90, asynchronous binary counter IC 74LS93, synchronous up/down counter IC 74LS193, Shift register IC 74LS95, design problems.

Textbooks:

1) R. P. Jain, “Modern digital Electronics”, Tata McGraw Hill, fourth edition.
2) A. Anand Kumar, “Fundamentals of Digital circuits”, PHI, Fourth edition.

Reference Book:

1) M. Morris Mano, Michael D. Ciletti, “Digital Design” Pearson, Fourth edition.
2) Thomas L. Floyd, “Digital Fundamentals” Pearson, Eleventh edition.

Digital Logic and Applications Design Laboratory
Course Outcomes: Students will be able to:
1. Implement Boolean functions using basic and universal logic gates. (BL3) 2. Design and implement combinational logic circuits for the given conditions. (BL3) 3. Design and implement sequential logic circuits for the given conditions. (BL3) **4.** Implement counter circuits using appropriate counter ICs. (BL3)
Experiments:
Slot 1 (Any 5)
1. Simplify given Boolean expressions and implement using basic logic gates/universal gates. 2. Design and implement the following circuits using logic gates: binary to gray code converter, gray to binary code converter, full adder. 3. Design and implement various multiplexer circuits using IC 74LS153. 4. Design and implement a full subtractor using decoder IC 74LS138. 5. Implement BCD adder circuit using IC 74LS83. **6.** Implement 4-bit and 8-bit magnitude comparator using IC 74LS85.
Slot 2 (Any 5)
7. Verify truth-tables of JK, T, D flip-flops and design a 2-bit asynchronous counter using IC 74LS76. 8. Design and implement mod-N counter using IC 74LS90. 9. Design and implement mod-N counter using IC 74LS93. 10. Design and implement synchronous up/down counter using IC 74LS193. Implement mod-N counter using preset pin. 11. Design and implement a sequence generator using JK flip-flops. Implement a 4-bit ring counter and twisted ring counter using IC 74LS95.

Engineering Graphics					
Course Code	ME(ES)-25002	**Examination Scheme**			
Teaching Scheme	2-0-2-1	**MSE**	30	**CIE**	100
Credits	3	**CIE**	20		
		ESE	50		

Course Outcomes: Students will be able to:

1. Familiarize with different drawing tools, technical standards and procedures for construction of different geometries and engineering objects.
2. Develop the ability to visualize and communicate three dimensional shapes and their sections by representing three-dimensional objects into two-dimensional views using concept of orthographic projection.
3. Apply the visualization practices to draw isometric projection from a given orthographic view.
4. Draw the development of lateral surfaces of assembly and cut sections of different geometrical solids for engineering applications.

Unit 1: Introduction to Engineering Drawing: **03 Hrs**

Drawing tools, drawing standards, line conventions, lettering, systems and rules of dimensioning

Unit 2: Orthographic Projections: **06**

Principles of Orthographic Projections, types of orthographic projections–First angle and third angle projections, obtaining orthographic projections of given solids and machine elements by using first angle projection method along with sectional views.

Unit 03: Isometric Projections: **06**

Principles of Isometric projection – Isometric and natural Scale, Isometric views of simple and compound solids, drawing isometric views from given orthographic views.

Unit 04: Development of lateral surfaces (DLS) of solids **03**

Industrial applications of development of lateral surface, methods of development, development of lateral surfaces for cut section of Prism, Pyramid, and Cone

Textbooks:

1) N.D.Bhatt, “Elementary Engineering Drawing”, Charotar Publishing House, Anand (India)
2) M.L.Dabhade, “Engineering Graphics” I, Vision Publications, Pune
3) Dhananjay Jolhe , “Engineering Drawing”, Tata McGraw Hill publishing company Ltd., New Delhi

Reference Books:

1) Warren Luzzader, “Fundamentals of Engineering Drawing”, Prentice Hall of India, New Delhi.
2) Shah, M.B. & Rana B.C. , “Engineering Drawing and Computer Graphics”, Pearson Education
3) Agrawal B. & Agrawal C. M. , “Engineering Graphics”, Tata McGraw Publication
4) Suraj Singh , “ Civil Engineering Building Practice ”

Course Title: Engineering Graphics Laboratory
Course Outcome: students will be able to
1. Familiarize with different drawing tools, technical standards and procedures for construction of different geometries and engineering objects. 2. Develop the ability to visualize and communicate three dimensional shapes and their sections by representing three-dimensional objects into two-dimensional views using concept of orthographic projection. 3. Apply the visualization practices to draw isometric projection from a given orthographic view. 4. Draw the development of lateral surfaces of assembly and cut sections of different geometrical solids for engineering applications.
List of Experiments/Assignments:
Draw 02 examples on each assignment on A2 size drawing sheet **Assignment 1:** Draw orthographic views of any machine elements along with sectional view. **Assignment 2:** Draw isometric view for given orthographic views. **Assignment 3:** Draw the development lateral surfaces of solids. **Draw 02 examples on following assignment using CAD software** **Assignment 4:** Draw orthographic views of any machine elements along with sectional view.

Fundamentals of Corrosion Engineering					
Course Code	MM(ES)-25002	**Examination Scheme**	Marks		
Teaching Scheme	2-0-2-1	**MSE**	30	**CIE**	100
Credits	3	**CIE**	20		
		ESE	50		

Course Outcome: students will be able to:

1. Understand the scientific principles and mechanisms underlying corrosion
2. Recognize basic corrosion types and forms
3. Apply foundational knowledge of prevention techniques and material selection
4. Demonstrate awareness of corrosion testing, standards, and good engineering practice

Unit 1. Introduction to Corrosion Science: **03 Hrs**

Definition and significance of corrosion in engineering, Every day and industrial examples of corrosion, Economic, environmental and safety impacts, Simple classification of corrosion types (wet/dry, chemical/electrochemical).

Unit 2. Scientific Principles of Corrosion: **03 Hrs**

Fundamental corrosion mechanisms, Chemical and electrochemical processes (basic), Anodic and cathodic reactions, Simple thermodynamic and kinetic concepts related to corrosion, Factors affecting corrosion: environment, material properties, and design

Unit 03. Forms of Corrosion & Prevention Methods: **03 Hrs**

Overview and scientific basis of common corrosion forms: Uniform, galvanic, pitting, crevice (introductory description), Material selection and basic prevention strategies, Surface protection: coatings, inhibitors, cathodic/anodic protection

Unit 04. Corrosion Measurement, Testing & Standards: **03 Hrs**

Principles of corrosion rate measurement and basic testing methods (weight loss, visual inspection). Introduction to industry standards (ASTM, NACE, IS—basic awareness), The role of inspection, certification, and data interpretation, The importance of safe engineering practice in corrosion science

Textbooks:

1) Fontana, M. G., Corrosion Engineering, 3rd Edition, McGraw-Hill, 2005.
2) Revie, R. W., & Uhlig, H. H., Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, 4th Edition, John Wiley & Sons, 2008.

Reference Books:

1) Cramer, S. D., & Covino, B. S. Jr. (Eds.), ASM Handbook, Volume 13B: Corrosion Fundamentals, Testing, and Protection, ASM International, 2010.
2) Kolman, D. G., Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, ASM International, 2017
3) NPTEL modules on Corrosion Science

Fundamentals of Corrosion Science (Practical)
Course Outcome: students will be able to
1. Measure corrosion rates and electrode potentials using basic techniques. 2. Identify and analyze major types of corrosion through experiments. 3. Apply corrosion control methods, including cathodic protection and inhibitors. 4. Interpret experimental data for engineering applications.
List of Experiments/Assignments:
1. To study the corrosion rate of metals in aqueous solutions and measure single electrode potential. 2. Polarisation techniques to determine corrosion rates. 3. Galvanic corrosion between dissimilar metals. 4. To study crevice corrosion in metal specimens. 5. Investigation of uniform corrosion. 6. Pitting corrosion observation in chloride solution. 7. Stress corrosion cracking (U-bend method). 8. Study of liquid metal embrittlement. 9. Cathodic protection demonstration. 10. Effect of inhibitors on corrosion prevention.

Product Prototyping Practices						
Course Code	MFG(ES)-25002		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**MSE**	30	**CIE**	100
Credits	3		**CIE**	20		
			ESE	50		

Course Outcomes:

1. Understand the fundamental principles of product prototyping and testing.
2. Develop practical skills to create functional and market-ready prototypes.
3. Learn to use modern prototyping tools and techniques.
4. Gain expertise in testing prototypes to ensure functionality, durability, and safety.
5. Equip students with the knowledge to start and manage their own product prototyping.

Course Content:

1. **Product Design and Conceptualization:** Idea generation and brainstorming techniques, Design thinking and user-centered design, Sketching and conceptual drawings, Creating design specifications and requirements
2. **Introduction to CAD Modeling and Digital Prototyping**: Introduction to CAD software, creating simple 3D models using parametric modeling.
3. **Introduction to Product Prototyping:** Overview of product prototyping, Importance of prototyping in product development, Types of prototypes
4. **Materials and Manufacturing Processes**: Selection of materials for prototyping, Selection of Process for prototypes, Overview of manufacturing processes, Rapid prototyping techniques
5. **Demonstration of various conventional Manufacturing Processes**: LASER Engraving, LASER Cutting, Wood Routing, Welding, Traditional prototyping tools like Hand tools & Power tools
6. **Introduction to Additive Manufacturing**: Introduction to AM, History of AM, its various types and Process flow of AM based FDM Technology
7. **Demonstration of various technologies under Additive Manufacturing:** This experiment will cover the learning of basic Additive Manufacturing techniques and its different industrial applications
8. **Prototype Testing and Validation:** Importance of prototype testing, Types of tests for product validation such as Functional testing & Durability testing, Cost estimation and budgeting
9. **Safety and Regulatory Considerations**

Course Outcomes: Upon completing this course, participants will be able to:

1. Conceptualize and design product ideas effectively.
2. Create functional and high-quality prototypes using modern tools and techniques.
3. Perform various tests to validate prototype functionality, durability, and safety.
4. Utilize advanced prototyping and testing technologies for improved product development.
5. Start and manage a successful product prototyping and testing consultancy or business

Textbooks:

1) Chua Chee Kai, Leong Kah Fai, “Rapid Prototyping: Principles and Applications”, World scientific, 2003.

2) Ian Gibson, David W Rosen, Brent Stucker., “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010 3) Ali K. Kamrani, Emand Abouel Nasr, “Rapid Prototyping: Theory and Practice”, Springer, 2006.
Reference Books:
1) Paul C. Bave: CAD Principles and Applications 2) Understanding of Additive Manufacturing, Andreas Gebhardt, Hnaser Publishers, 2011. 3) D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 200

[ES-01] Fundamentals of Electrical Engineering

Offered to all electrical students

Course Code	EE-25001		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**MSE**	30	**CIE**	100
Credits	3		**CIE**	20		
			ESE	50		

Course Outcomes: Students will be able to:

1. Analyze AC and DC circuits
2. Apply the principles of electric and magnetic circuits to solve engineering problems
3. Compute the efficiency and regulation of a single-phase transformer
4. Select motors for specific industrial applications
5. Use relevant protective devices for electrical installations measure various quantities by using common electrical measuring instruments

Unit 1: DC Circuits **[4 Hrs]**

Electrical circuit elements (R, L, and C), voltage and current sources, Kirchhoff's laws, analysis of simple DC circuits: Superposition, Thevenin and Norton theorems, Maximum Power Transfer theorem, DC transient in series RC, RL, parallel RC, RL circuits.

Unit 2: AC Fundamentals: **[4 Hrs]**

Sinusoidal voltage and currents, their mathematical and graphical representation, concept of cycle period, frequency, instantaneous, peak, average, r.m.s. values, peak factor, and form factor, phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasors.

Unit 3: AC Circuits: **[4 Hrs]**

Real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, R-L, R-C, R-L-C combinations, series resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections, three-phase power, Star-Delta transformation, concept of electric grid.

Unit 4: Magnetic Circuits and Transformers: **[6 Hrs]**

Magnetic materials, B-H curve, hysteresis loop, series and parallel magnetic circuits, ideal and practical transformers, equivalent circuit, losses in transformers, regulation, and efficiency. Auto transformer and three-phase transformer connections

Unit 5: Electrical Engineering Materials: **[6 Hrs]**

Properties, Characteristics, Classification and applications, insulating materials, Liquid Insulating Materials such as Transformer Oil, Varnish, Askarel. Insulating Gases like Air, SF6. magnetic materials, Magnetic materials for Electric Devices such as Transformer Core, Core of Rotating Machines, Soft Magnetic Materials, Hard Magnetic Materials. conducting materials, Materials used for Lamp Filaments, Solders, Metals and Alloys for different types of Thermal Bimetal and Thermocouples. dielectric materials.

Textbooks:

[1]	D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2nd Edition 2019
[2]	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 4th Edition, 2019
[3]	E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2010
[4]	S. P. Seth, "A Course in Electrical Engineering Materials", Dhanpat Rai Publications, 2011.

Reference Books:

[1]	Vincent Del Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 2nd Edition, 2015.
[2]	L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2nd Edition, 2003.

Fundamentals of Electrical Engineering: Laboratory	
Suggested List of Assignments in the Laboratory:	
1.	Overview of the Basic Electrical Engineering Lab (Equipment available: universal trolley, meters, transformers, loads, etc.) and safety precautions.
2.	Verification of Network Theorems:
3.	Connect a simple DC circuit with two loops and more than one source and measure all the branch currents and node voltages.
4.	Solve the same circuit applying Thevenin's, Norton's, and Superposition Theorems.
5.	Measure the voltage, current, and power in the R-L, R-C, and R-L-C series circuits and observe the phase difference between voltage and current using CRO.
6.	Connect the three-phase induction motor in star and delta and measure the line and phase voltages and currents to verify the relationship between line and phase quantities.
7.	Evaluation of Relative permeability and Magnetic reluctance of a 3-Limb core using an exciting coil of unknown number of turns.
8.	Flux diversion in the 3-Limb core by generating circulating currents in short-circuited conductor loop placed around the central limb.
9.	Determine the efficiency and regulation of a single-phase transformer by direct loading.

VSEC: Geomatic Engineering					
Course Code	CE(VS)-25001	**Examination Scheme**			
Teaching Scheme	1-0-2-1	**CIE**	20	**CIE**	50
Credits	2	**ESE**	30		

Course Outcomes: At the end of the course, the students are able to:

1. Apprehend the fundamental concepts and applications of various map types, coordinate systems, and datums.
2. Apply land surveying principles, including the use of levels and total stations, to collect accurate field data.
3. Analyze the operation and advanced functionalities of total station technology to support surveying and engineering tasks.
4. Create engineering drawings using AutoCAD software, demonstrating a comprehensive understanding of the program's components and commands.

Unit 1: Introduction to Mapping and Map Projections	**[3 Hrs]**

Maps- Importance of maps to engineering projects, Types of maps, Scales and uses, Plotting accuracy, Map sheet numbering, Coordinate systems- Cartesian and geographical, map projections, map datum – MSL, Geoid, spheroid, WGS-84.

Unit 2: Surveying Techniques	**[3 Hrs]**

Land Surveying- Various Levels, Levelling methods, Introduction to total station and Tachometer. Total station settings, parts of total station, uses of total station, Total station set up on station, different adjustment in total station

Unit 3: **Fundamentals of Total Station Measurements**	**[2 Hrs]**

Height measurement by Total station, Distance, and angle measurement by Total station

Unit 4: **Area Measurement Techniques**	**[2 Hrs]**

Area measurement by Total station, Resection and offset setting by Total station

Unit 5: **Computer-Aided Drafting in Surveying**	**[2 Hrs]**

Introduction to AUTO-CAD, Basic components of AUTO-CAD, Drawings using AUTO-CAD

Textbooks:

1. Kanetkar T.P. and Kulkarni S.V. “Surveying and Levelling – Part1”, Pune Vidyarthi Griha Prakashan, Pune.
2. Kanetkar T.P. and Kulkarni S.V. “Surveying and Levelling – Part2”, Pune Vidyarthi Griha Prakashan, Pune.

Reference books:

1. Duggal S. K. “Surveying Volume I”, Tata McGraw-Hill Publishing Company Limited. Duggal S. K. “Surveying Volume II”, Tata McGraw Hill Publishing Company Limited. Bannister A, Raymond S & Baker R. “Surveying”, Pearson Education Ltd.
2. Subramanium R., “Surveying & Levelling”, Oxford University Press. 52
3. Clark David, “Plane and Geodetic Surveying for Engineers Volume–I”, CBS, 6/E.
4. Clark David, “Plane and Geodetic Surveying for Engineers Volume II”, CBS, 6/E Clendinning J. “Principles of Surveying”, Blackie
5. Punmia B. C. “Surveying-I”, Laxmi Publications (P) Ltd. New Delhi Punmia B. C., Jain A, Jain A., “Surveying-II”, Laxmi Publications (P) Ltd. New Delhi

List of Laboratory Experiments

1.	Introduction to Basic Survey Instruments (With labelled sketch and coloured photos)
2.	Compass Traversing
3.	Levelling by Dumpy Level
4.	Levelling by Auto Level
5.	Introduction to Total Station (Explain in detail)
6.	Measurement of Distance using Total Station
7.	Measurement of Angle using Total Station
8.	Introduction to Modern Survey Instruments (e.g. DGPS, Drone, LIDAR, Scanner etc.)

VSEC: Fundamentals of Construction Practices					
Course Code	CE(VS)-25002	**Examination Scheme**			
Teaching Scheme	1-0-2-1	**CIE**	20	**CIE**	50
Credits	2	**ESE**	30		

Course Outcomes: Students will be able to:

1. *Demonstrate* safe use of basic construction tools and personal protective equipment (PPE) in simple site-related tasks
2. Apply the knowledge of types of masonry (brick, block, stone), and suitability to construction applications.
3. Apply knowledge of concrete ingredients, grades, batching and mixing methods
4. Evaluate common construction defects and their maintenance practices

Unit 1: Introduction to Construction Practices	**[5 Hrs]**
Scope and importance of construction in civil engineering, Types of construction works (buildings, roads, bridges, water works), Site layout and organization. Identification and handling of construction tools & PPE (Personal Protective Equipment)	
Unit 2: Masonry and Foundation Practices	**[5 Hrs]**
Types of masonry: brick, block, stone, Mortar preparation and applications, Introduction to foundations (shallow, deep – only basics).	
Unit 3: Concrete & Formwork Practices	**[5 Hrs]**
Ingredients of Concrete, Grades of Concrete, Batching Methods, Mixing of concrete Purpose of Formwork, Materials of Formwork, Requirements of Good Formwork, Formwork for Different Elements, Scaffolding	
Unit 4: Maintenance Practices	**[5 Hrs]**
Importance of maintenance in construction, Types of maintenance: routine, preventive, and special repairs, Common problems: cracks, dampness, leakage, corrosion, Simple repair methods: patch plastering, crack filling, waterproofing, painting renewal.	

Textbooks:

1. Sushil Kumar – *Building Construction*.
2. B. C. Punmia – *Building Construction*.
3. Rangwala – *Construction of Structures and Materials*.
4. National Building Code of India – Maintenance Provisions.
5. IS Codes on building maintenance and repairs.

List of Laboratory Assignments

1.	Prepare a simple site layout drawing for a small residential building including access road, storage area, and utilities.
2.	Prepare a chart/poster showing various Personal Protective Equipment (PPE) used on a construction site, their purpose, and correct usage
3.	Prepare a table showing different cement-sand mortar ratios and their typical applications in construction (e.g., plastering, brickwork, pointing).
4.	Prepare flowchart showing the steps of batching, mixing, placing, and curing of concrete.
5.	Identify a nearby building with visible cracks, dampness, or leakage. Write a one-page report with photos/sketches and suggest simple repair methods.

6.	Prepare a sample maintenance log sheet for a residential building, including common repair items.
7.	Visit construction sites and prepare a report

List of Experiments/Assignments:

1. Prepare a simple site layout drawing for a small residential building including access road, storage area, and utilities.
2. Prepare a chart/poster showing various Personal Protective Equipment (PPE) used on a construction site, their purpose, and correct usage
3. Prepare a table showing different cement-sand mortar ratios and their typical applications in construction (e.g., plastering, brickwork, pointing).
4. Prepare flowchart showing the steps of batching, mixing, placing, and curing of concrete.
5. Identify a nearby building with visible cracks, dampness, or leakage. Write a one-page report with photos/sketches and suggest simple repair methods.
6. Prepare a sample maintenance log sheet for a residential building, including common repair items.
7. Visit construction sites and prepare a report

VSEC: Programming for problem solving						
Course Code	CT(VS)-25001		**Examination Scheme**			
Teaching Scheme	1-0-2-1		**ESE**	30	**CIE**	50
Credits	2		**CIE**	20		

Course Outcomes: Students will be able to:

1. Represent real life data using data types and variables provided by programming language**.**
2. Solve a given problem using expressions, conditional statements, arrays and loops**.**
3. Design a modular solution using functions, by breaking down the problem into parts, using programming language**.**

Unit 1: Basic Programming Constructs	**[3 Hrs]**

Introduction and Overview of C programing Language, Constants and Variables, Assignments and Expressions, Introduction to Simple Input and Output Statements

Unit 2: Conditional and Control Flow Statements	**[3 Hrs]**

Conditional Statements: if, if..else, Control Flow: While do .. while, switch, for, break and continue, comma operator, goto statement

Unit 3: Array and function	**[3 Hrs]**

Strings, Arrays, Two Dimensional Arrays, Arrays of Arrays, Multi-Dimensional Arrays, Functions: Function Call, Definition and Declaration, Local and global variables, parameters, return types.

Unit 4: Structure and Pointers	**[3 Hrs]**

Structure: types, initialization, declaration, referencing, Pointer: Declaration, assigning values, constant pointers, initializing Pointers, pointer Arithmetic, pointer to text, array, structure

Textbooks:

[1]	R.G.Dromey, “How to solve it by Computer”, PearsonEducation
[2]	Balagurusamy, “Programming in ANSI C”, 9th Edition, McGraw Hill

Reference Books:

[1]	Stephen G. Krantz, “Problem Solving Techniques”, Universities Press.
[2]	Maureen Sprankle, “Problem Solving and Programming Concepts”, Pearson Education, ISBN-978-81-317-0711-1.
[3]	Kernighan and Ritchie, “The ‘C’ programming language”, Prentice Hall

List of Lab Experiments:

1. Exchanging the values of two variables, Summation of a set of numbers
2. Programs using basic programming constructs
3. Sine function computation, Series Computation, Roots of Quadratic Equation
4. Generation of the Fibonacci sequence, Finding the square root of a number
5. The greatest common divisor of two integers, Raising a number to large power
6. Finding the maximum number in a set, Array order reversal, Finding maximum number from an array of numbers
7. Removal of duplicates from an ordered array, Selection/ Bubble/ Insertion sort
8. Programs using Functions and Call by value type of parameter passing
9. Programs using storage class variables
10. Simple programs using pointer concepts, pointer arithmetic, Call by reference
11. Simple programs using structures and related concepts
12. Create a linked list and related operations

This list serves as a guideline and is intended to be continuously refined by the instructor.
Maximum 10 lab assignments need to be considered for continuous assessment and evaluation.

VSEC: Web Design						
Course Code	CT(VS)-25002		**Examination Scheme**			
Teaching Scheme	1-0-2-1		**ESE**	30	**CIE**	500
Credits	2		**CIE**	20		

Course Outcomes: Students will be able to:

1. Demonstrate ability to install and configure a web server
2. Design a specified webpage using HTML and CSS.
3. Demonstrate the ability to manipulate DOM objects using JavaScript.

Unit 1: Web Essentials	**[2 Hrs]**

Basics of the Internet and the Web, Clients, servers, communication, protocols, HTTP request/response cycle, Web browsers and their role. Tools and setup: text editors, browsers, debugging tools. Installation and configuration of a web server.

Self-Learning Topic: Difference between the Internet and the World Wide Web.

Unit 2: Hypertext Markup Language	**[2 Hrs]**

Fundamental HTML elements (head, body, title, headings, paragraphs), Attributes and basic formatting (bold, italic, links, lists, images), Tables, Forms

Self-Learning Topic: Difference between HTML elements and attributes.

Unit 3: Cascading Style Sheets	**[2 Hrs]**

CSS3 introduction (syntax, Types of CSS), Basic Style Properties (color, font, background, margins, padding, borders), the box model and display property (block, inline, inline-block), simple selectors (element, class, ID)

Self-Learning Topic: Concept of the CSS box model and its importance.

Unit 4: JavaScript & Basic of Node.js	**[6 Hrs]**

JavaScript basics, control flow, functions and arrays, events and DOM manipulation, and simple form validation. Introduction to Node.js, creating a simple HTTP server, serving static files (HTML, CSS, JavaScript), processing form submissions (GET and POST methods), and a simple client–server communication example (browser form as client, Node.js as server).

Self-Learning Topic: Node.js and its use in server-side programming

Textbooks:

[1] Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics, Jennifer Niederst Robbins, 5th Edition, 2018, ISBN-13: 978-1491960202

Reference Books:

[1] HTML & CSS: Design and Build Websites, Jon Duckett, 1st Edition, 2014, ISBN-13: 978-1118008188

[2] JavaScript and JQuery: Interactive Front-End Web Development, Jon Duckett, 1st Edition, 2014, ISBN-13: 978-1118531648

[3] Eloquent JavaScript, Marijn Haverbeke, 4th Edition, 2024, ISBN-13: 978-1718504103

Web Sources:

[1] **H** Html: http://geeksforgeeks.org/html/html-tutorial/

[2] CSS: https://www.geeksforgeeks.org/css/css-tutorial/

[3] HTML, The Complete Reference http://www.htmlref.com/

[4] JavaScript: https://www.w3schools.com/js/

[5] Node.js: https://www.geeksforgeeks.org/node-js/nodejs/

[6] https://developer.mozilla.org/en-US/docs/AJAX

[7]	Eloquent JavaScript https://eloquentjavascript.net/

List of Lab Experiments:

[1]	Set up your web development environment by installing a text editor (VS Code) and a browser. Create a new folder, add an index.html file with some text ("Hello World"), and open it in the browser to check if everything works.
[2]	Create a basic HTML page using <!DOCTYPE>, <html>, <head>, <title>, and <body>. Add headings, a paragraph, and apply text formatting like **bold**, *italic*, and underline. Insert an image and a hyperlink that opens another
[3]	webpage. Create a new HTML page that includes both an **ordered list** and an **unordered list** for items like hobbies, subjects, or favorite foods. Add a **table** with at least three rows and three columns, such as a simple timetable or contact list.Create a new HTML page that includes both an **ordered list** and an **unordered list** for items like hobbies, subjects, or favorite foods. Add a
[4]	**table** with at least three rows and three columns, such as a simple timetable or contact list.
[5]	Build a two-page personal website with navigation links to switch between pages. On one page, include a **form** with Name, Email, and Message fields. Style your HTML page using **inline CSS** (inside tags) and **internal CSS**
[6]	(inside a <style> block). Change the background color, text color, and font style to see the difference between the two.
[7]	Create an **external CSS file** and link it to your HTML page. Use it to style headings, paragraphs, and images with borders, margins, padding, and different fonts.
[8]	Demonstrate the **box model and selectors** by styling a with margin, border, and padding. Apply element, class, and ID selectors to design a
[9]	simple profile card or blog section. Add a JavaScript script to your HTML page that shows a **welcome alert**
[10]	**message** when the page loads. Also, display today's date inside a paragraph using DOM manipulation.
[11]	Create a **button** on your webpage that changes the background color when clicked. Add another button that hides and shows an image using JavaScript
[12]	events. Add a simple **form validation** script to check if the Name and Email fields
[13]	are not empty before submission. Show an alert if any field is left blank. Install **Node.js** and create a new project folder. Write a simple JavaScript program that prints "Hello, Node.js!" in the terminal. Create a basic **HTTP server** in Node.js that responds with "Hello World" when accessed in the browser. Test it by opening http://localhost:3000. Extend your Node.js server to **serve static files** like HTML, CSS, and JavaScript. Add a simple form in HTML and handle its submission on the server using **GET and POST methods**.

This list serves as a guideline and is intended to be continuously refined by the instructor.

VSEC: Python Programming						
Course Code	CT(VS)-25003		**Examination Scheme**			
Teaching Scheme	1-0-2-1		**ESE**	30	**CIE**	50
Credits	2		**CIE**	20		

Course Outcomes: Students will be able to:

1. Represent real life data using data types and variables provided by programming language.
2. Solve a given problem using expressions, conditional statements and loops.
3. Design a modular solution using functions, by breaking down the problem into parts, using programming language.
4. Demonstrate the ability to process files of various types.

Unit 1: Introduction	**[3 Hrs]**

Basics of Python Programming: Introduction to Python, Setting up the environment, Variables, Data types, Operators, Comments, Basic syntax, Python Data Types: Numbers (int, float), Strings, Booleans, Lists, Tuples, Sets, Dictionaries Python Operators: Arithmetic operators, Comparison operators, Logical operators, Assignment operators, Bitwise operators, Identity operators

Unit 2: Python Control Flow	**[3 Hrs]**

Python Conditional Statements: if, elif, else statements, Nested conditions Python Loops: for loop, while loop, break statement, continue statement, pass statement

Unit 3: Python Data Structures	**[3 Hrs]**

Lists and List Comprehensions: Creating lists, accessing elements, List operations (append, insert, remove, etc.), List comprehensions. Tuples, Dictionaries and Sets: Creating dictionaries and sets, accessing elements, Dictionary and set operations

Unit 4: Strings and Functions	**[3 Hrs]**

Strings and String Manipulation: String operations (concatenation, slicing, splitting, etc.), String methods. Python Functions: Defining functions, calling functions, Function arguments, Return values, Scope of variables

Textbooks:

[1]	R. G. Dromey, “How to solve it by Computer”, Pearson Education, ISBN 0-13-433995-9
[2]	Maureen Sprankle, “Problem Solving and Programming Concepts”, Pearson Education, ISBN-978-81-317-0711-1
[3]	Al Sweigart, Automate the Boring Stuff with Python: Practical Programming for Total Beginners, No Starch Press, ISBN 978-1-59327-599-0.
[4]	John M. Zelle, Python Programming: An Introduction to Computer Science, Franklin, Beedle & Associates, ISBN 978-1-59028-275-5.

Reference Books:

[1]	Stephen G. Krantz, “Problem Solving Techniques”, Universities Press.
[2]	Reema Thareja, “Python Programming: Using Problem Solving Approach”, Oxford University Press; First edition, 978-0199480173
[3]	Wes McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, O’Reilly Media, ISBN 978-1-4493-1979-3.

Web Sources:

[1]	**W3Schools Python Tutorial**: https://www.w3schools.com/python/
[2]	**Kaggle Learn – Python**: https://www.kaggle.com/learn/python
[3]	**TutorialsPoint – Python Programming:** https://www.tutorialspoint.com/python/index.htm
[4]	**GeeksforGeeks – Python Programming Language**: https://www.geeksforgeeks.org/python-programming-language/
[5]	NPTL Course webpage: https://onlinecourses.swayam2.ac.in/cec22_cs20/preview

List of Lab Experiments:

1. 1.Simple Data Manipulation and Calculations: Write a program to calculate the area and perimeter of a rectangle using user input, variables, and basic arithmetic operations.
2. Working with User Input and Conditional Logic: Create a program that determines if a user-input number is positive, negative, or zero, and whether it's even or odd, using if-else statements.
3. Iterating and Calculating with Loops: Use a for loop to find the sum of numbers up to a given integer and a while loop to sum numbers until a sentinel value (e.g., 0) is entered.
4. Exploring Lists and Their Operations: Perform various list manipulations on a list of numbers, including appending, inserting, removing, and sorting elements.
5. Applying List Comprehensions: Use list comprehensions to create new lists by squaring all even numbers and extracting strings from an existing list.
6. Managing Data with Dictionaries: Build a program that uses a dictionary to store, update, and display student information, including calculating an average grade.
7. Manipulating Strings: Write a program to perform various string operations on a user-provided sentence, such as counting vowels, reversing the string, and checking for palindromes.
8. Introduction to Functions: Define and call functions to calculate the average of a list of numbers and reverse a string, with the main program using these functions.
9. Functions with Arguments and Return Values: Create functions that utilize different types of arguments (default, variable number) and return multiple values.
10. Combining Concepts: A Mini-Project: Develop a simple command-line contact management system that uses functions, a dictionary, and a main loop to add, search for, and display contact information**.**

(VSEC-01) Electrical Maintenance and Safety

Offered to all students

Course Code	EE(VS)-25001		**Examination Scheme**			
Teaching Scheme	1-0-2-1		**ESE**	30	**CIE**	50
Credits	2		**CIE**	20		

Course Outcomes: Students will be able to:

1. Understand and carry out maintenance of various household and industrial wiring systems.
2. Understand testing, performance and maintenance of transformer and induction motors
3. Understand and carry out maintenance of inverter, stabilizer, power supplies.
4. Understand and carry out maintenance, installation wiring of automatic water level controller, solar PV system, streetlight control system.
5. Understand and carry out maintenance of EV charger for various applications.

This course contains study of different types of electrical wiring, installation and maintenance practices. Types of earthing, its importance and installation. PS/Inverter/Stabilizer working principle and maintenance, Solar PV system and its application like solar water heater, Industrial Motor installation practices, Double pole structure of transformer wiring installation and maintenance, automated street lighting, solar lighting, wiring and maintenance, Water level controller and its maintenance charger its wiring and maintenance.

Textbooks:

[1]	S. L. Uppal and G. C. Garg, Electrical Wiring Estimating & Costing, Khanna Publishers, 2010.
[2]	H. Pratap, Art and Science of Utilization of Electrical Energy, Dhanpat Rai & Sons, 2009.

Reference Books:

[1]	Web site for IS Standards.
[2]	Technical manual of Switchgear Industry.

Web Resources:

[1]	1. NPTEL online course, Basic Electrical Technology – IIT Kharagpur
[2]	https://nptel.ac.in/courses/108/102/108102146/
[3]	2. Energy.gov, Commercial and Residential Energy Efficiency Resources
	https://www.energy.gov/
[4]	3. NPTEL online course, Illumination Engineering – IIT Madras
	https://nptel.ac.in/
[5]	4. National Digital Library of India (NDLI), Electrical Safety and Installation Resources
	https://ndl.iitkgp.ac.in/
	5. Electrical Engineering Portal, Earthing and Grounding Systems
	https://electrical-engineering-portal.com/

Lab Assignments

[1]	Study and maintenance and installation of household electrical wiring.
[2]	Study and maintenance and installation of commercial electrical wiring
[3]	Study and maintenance and installation of industrial electrical wiring.
[4]	Study of electrical installation of earthing, its maintenance and safety.
[5]	Study and maintenance and installation, wiring of transformer double pole structure
[6]	Study of solar water heater system and its maintenance.
[7]	Study of industrial motors wiring, installation and its maintenance.
[8]	Study of automatic water level controllers its wiring installation and maintenance.
[9]	Study of EV charger system and its maintenance

[10]	Study of solar PV system and its maintenance.
[11]	Study of lift system and its maintenance.
[12]	Study of Inverter/UPS/stabilizer system and its maintenance.
[13]	Study of automated street lighting, solar lighting and its maintenance.

[VSEC-01] Electrical Workshop						
Course Code	EE(VS)-25002		**Examination Scheme**			
Teaching Scheme	1-0-2-1		**ESE**	30	**CIE**	50
Credits	2		**CIE**	20		

Course Outcomes: Students will be able to:

After successful completion of this course students will be able to:

1. Identify/locate faults and carryout repairing of domestic and industrial wiring installation.
2. plan and prepare earthing installation.
3. use winding machine for winding of transformer, motors etc.
4. prepare PCB layout, construct and test electronic circuits
5. design and wire up control panel for industrial applications.
6. **Install rooftop solar PV/inverter and batteries.**

Prepare test board/extension board and mount accessories like lamp holders, various switches, sockets, MCB, indicating lamp etc., Testing/Fault detection of domestic/industrial wiring and repair, Practice wiring of 415 V, 3 HP, 3-phase induction motor as per IE rules, Prepare plate/pipe earthing and measure earth resistance, Practice on winding of small transformer, Practice on winding of 3-phase induction motor, Make a printed circuit board for small electronic circuit, Control panel wiring for forward reverse control/star-delta starter/sequential control of motors, Installation and connection of inverter/UPS with battery for domestic wiring, Connect solar panel for given AC and DC load, Energy Audit or Power Quality Audit of Commercial building/Small industry/Hospital/Institute etc, Design experiments based on visit to pumping station/wastewater treatment plant/sewage

Textbooks:

[1]	Uppal, S. L., & Gupta, J. B. (2012). *Electrical Wiring Estimating and Costing*. New Delhi: S. K. Kataria & Sons.
[2]	Mehta, V. K., & Mehta, R. (2012). *Basic Electrical Engineering* (Revised ed.). New Delhi: S. Chand Publishing.
[3]	Khandpur, R. S. (2005). *Printed Circuit Boards: Design and Technology*. New Delhi: Tata McGraw-Hill Education.

Reference Books:

[1]	Guidebooks for National Certification Examination for Energy Manager/Energy Auditors Book General Aspects (available online)

Web Resources:

[1]	1. Lecture Series on Basic Electrical Technology by Prof. L. Umanand, Principal Research Scientist, Power Electronics Group, CEDT, IISC Bangalore, 2. https://www.youtube.com/watch?v=rLUyP6g1VNI&list=PL425060D3C78350E1

List of Experiments/Assignments:

[1]	Prepare test board/extension board and mount accessories like lamp holders, various switches, sockets, MCB, indicating lamp etc.
[2]	Testing/Fault detection of domestic/industrial wiring and repair
[3]	Practice wiring of 415 V, 3 HP, 3-phase induction motor as per IE rules
[4]	Prepare plate/pipe earthing and measure earth resistance
[5]	Practice on winding of small transformer
[6]	Practice on winding of 3-phase induction motor
[7]	Make a printed circuit board for small electronic circuit

[8]	Control panel wiring for forward reverse control/star-delta starter/sequential control of motors
[9]	Installation and connection of inverter/UPS with battery for domestic wiring
[10]	Connect solar panel for given AC and DC load
[11]	Energy Audit or Power Quality Audit of Commercial building/Small industry/Hospital/Institute etc.
[12]	Design experiments based on visit to pumping station/waste water treatment plant/sewage treatment plant etc.

Digital Public Infrastructure						
Course Code			**Examination Scheme**			
Teaching Scheme	1-0-2-1		**ESE**	30	**CIE**	50
Credits	2		**CIE**	20		

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Explain the concept and importance of Digital Public Infrastructure. (BL2)
2. Describe digital identity systems and their role in inclusion and authentication. (BL2)
3. Apply the principles of digital payments such as UPI for financial transactions. (BL3)
4. Explain consent-based data sharing and privacy in DPI ecosystems. (BL2)
5. Discuss the role of open networks, APIs, and global practices in innovation and governance. (BL3)

Unit 1: Introduction to DPI: **(3 hrs)**

Definition and need for DPI. Characteristics of DPI: Scalability, interoperability, privacy. Global DPI initiatives: Estonia's X-Road, Singapore's GovTech, and India Stack. DPI and Sustainable Development Goals (SDGs) – How DPI supports financial inclusion, governance, and digital equity.

Unit 2 **(3 hrs)**

Key Components of DPI: Decentralised Identity Management (DID) – Use of blockchain for secure identity verification. Digital Identity: Aadhaar as a case study. Payment Systems: UPI and its impact on financial inclusion. Real-time payment systems – Exploring frameworks beyond UPI, like FedNow (USA), PIX (Brazil), and FPS (UK). Data Empowerment: Consent-driven data sharing (DEPA). Open Marketplaces: Overview of ONDC and its potential for e-commerce.

Unit 3 **(3 hrs)**

Societal Impacts of DPI: Financial inclusion through UPI. Transforming governance with digital identity. Ethical challenges: Privacy, inclusion, and data security. DPI's role in cross-border digital infrastructure – Adoption of India's DPI model by different countries (e.g., Brazil's PIX, Africa's DPI projects). Geopolitics and Emerging Markets: Overview of DPI's geopolitical implications (e.g., cyber threats, data sovereignty) and opportunities in emerging markets (e.g., Africa, Southeast Asia). DPI as a foundation for innovation and startups – Economics of various components of DPI

Unit 4 **(3 hrs)**

DPI Governance and Policy: Overview of data privacy laws (General Data Protection Regulation (GDPR), Indian Data Protection Bill, and UNDP DPI Playbook). Principles of Open Banking – UK's Open Banking, Europe's PSD2, and how they compare with UPI & ONDC. Principles of open standards vs. proprietary systems. Zero-Knowledge Proofs (ZKP) in DPI – Privacy-enhancing cryptographic techniques for data sharing without revealing identity. Ensuring inclusion and addressing biases.

Unit 5 **(3 hrs)**

Case Studies and Applications: Aadhaar: Digital identity-enabling government schemes. UPI: Democratising digital payments. ONDC: Decentralised digital marketplaces. Smart Contracts & DPI – How Ethereum-based contracts can automate governance and payments. International examples: Estonia's X-Road and GovTech Singapore. Hands-on API Integration – Exploring Open Banking APIs for personal finance management, lending, and investment tracking.

References:

1. India Stack Documentation – https://indiastack.org
2. Nilekani, N. & Shah, V. Rebooting India: Realizing a Billion Aspirations, Penguin Random House India, 2015.

3. World Bank. Digital Public Infrastructure: Safe, Trusted, Inclusive, World Bank Report, 2023.
4. MeitY, Government of India. India Digital Ecosystem Reports, 2021–2023.
5. UNDP & GovTech. Digital Public Infrastructure: A Shared Resource for Sustainable Development, UNDP Report, 2022.

Digital Public Infrastructure Lab

Course Outcomes:

At the end of the course, students will demonstrate the ability to

- Demonstrate basic features of digital identity, payments, and data sharing. (BL2)
- Use sample APIs (UPI, ONDC, Open Banking) to simulate digital transactions. (BL3)
- Apply principles of interoperability and privacy in simple data-sharing experiments. (BL3)
- Analyze real-world case studies of DPI applications and their impact. (BL3)
- Develop a small prototype or conceptual model using DPI concepts. (BL3)

List of Experiments/Assignments:

1. **Introduction to Digital Public Infrastructure**
    - Familiarization with India Stack (Aadhaar, UPI, ONDC).
    - Explore global DPI initiatives (Estonia X-Road, GovTech Singapore) through online portals and documentation.
2. **Digital Identity Systems**
    - Simulation of digital KYC using mock Aadhaar/e-KYC APIs.
    - Explore blockchain-based decentralized identity (DID) demo platforms.
3. **UPI and Digital Payment Systems**
    - Analyze the working of UPI through a mobile application.
    - Compare UPI with international systems like PIX (Brazil) or FedNow (USA) via case study.
4. **Consent-driven Data Sharing (DEPA Model)**
    - Simulate data-sharing with consent artifacts (mock data sharing between banks/fintechs).
    - Discussion on privacy-preserving data use cases.
5. **Open Digital Marketplaces (ONDC)**
    - Explore ONDC network principles and open protocols.
    - Small project: Simulate seller–buyer interactions in an open marketplace model.
6. **DPI and Open Banking APIs**
    - Hands-on with sample Open Banking APIs (personal finance, lending, or investment tracking).
    - Analyze data flow and security in financial APIs.
7. **Privacy and Security in DPI**
    - Demonstration of cryptographic methods: Hashing, digital signatures.
    - Explore Zero-Knowledge Proof (ZKP) concepts using simple online tools/demos.
8. **Governance and Policy Simulation**
    - Group discussion/role play: Create a policy framework for digital identity or payments.
    - Debate on GDPR vs. India's Data Protection Bill.
9. **Case Study Assignment**
    - Aadhaar for government schemes, UPI for financial inclusion, ONDC for digital marketplaces.
    - International comparison: Estonia X-Road, Singapore GovTech.
10. **Mini Project (Integrative)**

Students develop a small application or conceptual prototype using APIs (mock UPI, Open Banking, ONDC).

• Example: “College Marketplace” on ONDC principles or a “Budget Tracker” app with payment APIs.
Resources:
• https://www.npci.org.in/what-we-do/upi/product-overview (For simulating payment transactions) • https://ondc.org (For open network protocols, seller-buyer marketplace simulation) • Razorpay, Paytm Developer Docs (Sandbox access available). • https://dpilabs.worldbank.org (Interactive global DPI case studies and experiments). • https://x-road.global and https://www.tech.gov.sg (For comparative assignments). • **Mozilla Privacy and Security Learning Resources -** Simple cryptography demos (hashing, digital signatures, ZKP concepts). • **Blockchain-based Digital Identity (Demo Platforms) -** Sovrin, uPort, or Microsoft ION (For lab exploration of decentralized identity).

Data Pre-processing and Visualization						
Course Code	ETC(VS)-25001		**Examination Scheme**			
Teaching Scheme	1-0-2-1					
Credits	2		**ESE**	30	**CIE**	50
			CIE	20		

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

- Identify the importance of data visualization and preprocessing
- Select and use appropriate visualization Techniques
- Apply data visualization techniques for analyzing the data
- Interpret results of exploratory data analysis
- Apply different preprocessing techniques on data

Unit 1 Fundamentals of Data Visualization	**(4 hrs)**

Overview of data visualization and its importance, Principles of visual perception and cognition, Acquiring and Visualizing Data ,Choosing appropriate visualizations for different data types, Simultaneous acquisition and visualization , exploratory data analysis techniques, Applications of Data Visualization

Unit 2 Data Visualization Techniques	**(3 hrs)**

Graphs and charts for categorical data, bar charts, gantt charts, stacked bars , line plots, scatter plots, area chart , pie chart and bubble charts, heatmaps, treemaps,box and whisker plots, histograms, word cloud , geo maps, interactive data visualization

Unit 3 Introduction to Dashboard Design	**(4hrs)**

Introduction to dashboard design principles, exploring different types of dashboards, defining the purpose and objectives of the dashboard , data visualization style guide, v**isual hierarchy and layout design, performance and optimization of dashboard, dashboard deployment and distribution, dashboard evaluation methods**

Unit 4 Introduction to Data Pre-Processing	**(4 hrs)**

Importance and role of data preprocessing, challenges and issues in real-world datasets, preprocessing techniques- aggregation, sampling, dimentionality reduction, feature selection, discretization, data quality and cleaning techniques,handling missing data and outliers, data normalization and standardization, handling time series data

References:

1. Schwabish, Jonathan. Better data visualizations: A guide for scholars, researchers, and wonks. Columbia University Press, 2021
2. Min Chen,Helwig Hauser, Penny Rheingans, Gerik Scheuermann,'Foundations of Data
3. Visualization',Springer, 2020
4. Andy Kirk, 'Data Visualisation: A Handbook for Data Driven Design' SAGE Publication, 2019
5. Alexandru C. Telea 'Data Visualization: Principles and Practice', CRC Press, 2014
6. **Stephen Few, 'Information Dashboard Design: Displaying Data for At-a-Glance Monitoring',** Analytics Press; 2nd edition , 2013
7. Ben Fry, 'Visualizing data: Exploring and explaining data with the processing environment',
    a. O'Reilly, 2008
8. Salvador García, Julián Luengo, and Francisco Herrera , 'Data Preprocessing in Data Mining', Springer , 2014
9. Pang-Ning Tan,Michael Steinbach,Vipin Kumar 'Introduction to Data Mining', Pearson Addison-Wesley, Second Edition

Data Pre-processing and Visualization Lab

Course Outcomes:

At the end of the course, students will demonstrate the ability to

- Classify and Transform the given data into visual presentation using visualization tools
- Prepare dashboard to visualize summarized data
- Perform Pre-processing operations on data

List of Experiments:

1. Download any free data set (from tableau/kaggle etc) in excel format and prepare the following using it:
    - bar charts
    - area chart
    - pie charts
    - line plots
    - scatter plots
2. Download any free data set and prepare the following using it:
    - Heat map
    - Tree map
    - Histogram
3. Study of any of the visualization tools
    - Tableau
    - Power BI
    - **Domo**
    - **Excel**
4. **Use of Python libraries such as** Matplotlib, Seaborn, Plotly **to visualize data in the given dataset**
5. Prepare a Dashboard using any one sourse software. e.g. Tableau, Microsoft POWER BI, Google data Studio
6. Install WEKA on your system and study different features
7. Use WEKA tool for feature extraction and filtering

Resources:

1. Kalilur Rahman, 'Python Data Visualization Essentials Guide: Become a Data Visualization expert by building strong proficiency in Pandas, Matplotlib, Seaborn, Plotly, Numpy, and Bokeh,BPB Publication, 2021

2. Ryan Sleeper, 'Practical Tableau'O'Reilly Media Inc, 2018

3. Bostjan Kaluza, 'Instant Weka How-to', Packt Publishing, 2013

Fundamentals of Programmable Logic Controllers (PLC)					
Course Code	ICE(VS)-25001	**Examination Scheme**			
Teaching Scheme	1-0-2-1	**CIE**	20	**CIE**	50
Credits	2	**ESE**	30		

Course Outcomes:

Explain the generic architecture and constituent components of a Programmable Logic Controller.
Develop a ladder logic program using modern engineering software tools and technique for analog and discrete control.
Apply knowledge gained about PLCs to identified real-time industrial applications.

Unit 1: Introduction to PLC **[4 Hrs]**

Role of automation in Industries, benefits of automation, Necessity of PLC, History and evolution of PLC, Definition, types, selection criterion, Overall PLC system, PLC Input and output modules, CPU, programmers and monitors, power supplies, Solid state memory.

Unit 2: PLC Programming **[4 Hrs]**

PLC programming techniques, Ladder diagram fundamentals, Boolean logic and relay logic, AND, OR, NOR NAND, Timer and counter- types along with timing diagrams

Unit 3: Applications of PLC **[5 Hrs]**

Input ON/OFF switching devices, Input analog devices, Output ON/OFF devices, Output analog devices, programming ON/OFF Inputs to produce ON/OFF outputs. Motor Sequencing Operation, Tank level control, car parking.

Textbooks:

1) Introduction to Programmable controller by GarryDunning,2ndEdition, ThomsonAsia, Pte, Ltd, Singapore, 2002.
2) Programmable Logic Controllers Programming Methods and Applications by JohnR. Hackworth, Frederick D., Hackworth Jr., 3rd edition, Pearson Education, 2005.
3) Programmable Logic Controllers with Applications by P. K. Srivstava, BPB Publications, 1 st edition, 2001.
4) Programmable Controllers Theory and Implementation by L.A.Bryan, E.A.Bryan, Industrial Text Company Publication, 2nd edition, 1998.

Computer Aided Drafting					
Course Code	ME(VS)-25001	**Examination Scheme**			
Teaching Scheme	1-0-2-1	**ESE**	30	**CIE**	50
Credits	2	**CIE**	20		

Course Outcomes: At the end of the course, students will demonstrate the ability to

1. Draw 2D geometric figures using CAD software
2. Modify 2D geometric figures using CAD software
3. Use software to dimension and write text on existing 3D geometric entities
4. Create isometric drawing using CAD software.
5. Use layers and blocks to create digital drawings.
6. Use appropriate 3D toolbars& commands to create 3D models.

01: Orthographic Projections: **02 Hrs**

Principles of Orthographic Projections, types of orthographic projections–First angle and third angle projections, obtaining orthographic projections of given solids and machine elements by using first angle projection method along with sectional views.

02: Fundamentals of CAD drawing setup **03 Hrs**

Various software for computer aided drafting and its applications. Co-ordinate system. CAD initial setting commands. Object selection methods

03: Draw, Zoom and Formatting Commands **02 Hrs**

Draw Commands: Line. Arc, circle, rectangle, polygon, ellipse, spline, block , hatch etc.
Zoom Commands: All, previous, In, Out, extent, dynamic, Window, Pan etc
Formatting Commands: Layers, line type, line weight, color etc.

04: Edit and Modify Commands: **02 Hrs**

Edit Commands: Move, Copy, Lengthen, stretch
Modify Commands: Erase, Trim, Mirror, Offset Fillet, Chamfer, Array, Rotate, Scale, Break

05: Dimensioning, Text and plot commands **02 Hrs**

Dimensioning Commands: Dimension style, Dimension modify, Dimension tolerance

06: Introduction to 3D Modeling **03 Hrs**

3D Model Making. Use of appropriate toolbars and commands to create 3D models

Textbooks:

1. M.L.Dabhade, “Engineering Graphics” I, Vision Publications, Pune
2. Dhananjay Jolhe , “Engineering Drawing with an introduction to AUTOCAD”, Tata McGraw Hill publishing company Ltd., New Delhi

Reference Books:

1. Shah, M.B. & Rana B.C., “Engineering Drawing and Computer Graphics”, Pearson Education

Computer Aided Drafting Laboratory
Corse Outcomes: At the end of the course, students will demonstrate the ability to
1. Draw 2D geometric figures using CAD software 2. Modify 2D geometric figures using CAD software 3. Use software to dimension and write text on existing @D geometric entities 4. Use layers and blocks to create digital drawings. 5. Use appropriate 3D toolbars& commands to create 3D models
List of Assignment: Draw 04 examples on each assignment using CAD software
Assignment 1: Draw orthographic views of any machine elements along with sectional view. **Assignment 2:** Create 3D models for given orthographic views.

Course: Electric Vehicle architecture					
Course Code	ME(VS)-25002	**Examination Scheme**			
Teaching Scheme	1-0-2-1	**MSE**	30	**CIE**	50
Credits	02	**CIE**	20		

Course Objectives

1.To introduce the fundamentals of automobiles with a focus on Electric Vehicles (EVs).
2.To understand EV architecture, working principles, and essential components.
3.To study the role of suspension and tyres in EV performance.
4.To provide practical exposure to EV components and systems through lab activities.

1 Introduction to Automobiles	03 **Hrs**

History and evolution of automobiles., Classification of vehicles (2W, 3W, 4W, HEV, PHEV, BEV, FCEV), Layout of an automobile – chassis, power train, transmission, brakes, steering, Basics of vehicle dynamics – traction, rolling resistance, braking, and aerodynamics

2 Basics of Suspension & Tyres for EVs	03 **Hrs**

Purpose and classification of suspension systems., Types: leaf spring, coil spring, torsion bar, air suspension., Suspension requirements in EVs (extra weight due to battery, low centre of gravity), Tyre construction – bias ply vs radial tyres, Tyre ratings: load index, speed rating, tyre pressure, Low rolling resistance tyres for EVs.

3 Introduction to Electric Vehicles	03 **Hrs**

Need for EVs – energy, environment, and sustainability. EV vs ICE vehicle comparison. Types of EVs: HEV, PHEV, BEV, FCEV. EV architecture – motor, controller, battery pack, charging system, regenerative braking. Case studies: Tesla, Tata Nexon EV, Ola S1, BYD.

4 **EV Components & Working Principles**	03 **Hrs**

Electric motors for EVs – BLDC, PMSM, Induction. Batteries – lead-acid, lithium-ion (working, capacity, charging/discharging).Battery Management System (BMS).Charging methods – AC, DC fast charging, connectors, standards. Introduction to power electronics in EVs.

5 EV Industry & Future Trends	02 **Hrs**

Government policies and incentives (FAME-II, charging infra).Challenges in EV adoption – cost, range anxiety, recycling. Emerging trends – solid-state batteries, wireless charging, hydrogen fuel cells, autonomous EVs.

Reference Books

Automobile Basics (for fundamentals)

1. "Automobile Engineering Vol. I & II" – Kirpal Singh, Standard Publishers
2. "Automobile Engineering" – R.K. Rajput, Laxmi Publications
3. "A Textbook of Automobile Engineering" – K.K. Jain & R.B. Asthana, Tata McGraw Hill

"Vehicle Dynamics: Theory and Application" – Reza N. Jazar, Springer

Electric Vehicles & EV Technology

1. "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles" – Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, CRC Press
2. "Electric and Hybrid Vehicles: Design Fundamentals" – Iqbal Husain, CRC Press
3. "Electric Vehicle Technology Explained" – James Larminie & John Lowry, Wiley
4. "Fundamentals of Electric Vehicles: Technology and Economics" – Sandeep Dhameja, Newnes/Elsevier
5. "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives" – Chris Mi, M. Abul Masrur, David Wenzhong Gao, Wile

Reference Papers / Reports

1. International Energy Agency (IEA) – *Global EV Outlook* (Annual report, latest edition).
2. Society of Indian Automobile Manufacturers (SIAM) – Reports on EV adoption in India.
3. NITI Aayog & Rocky Mountain Institute (RMI) India – *India's Electric Mobility Transformation*.
4. Ministry of Heavy Industries, Govt. of India – *FAME-II Scheme Guidelines and Reports*.
5. SAE Technical Papers on EV architecture, battery technologies, and charging systems.
6. IEEE Transactions on Vehicular Technology / Transportation Electrification – Research papers on EV motors, BMS, charging infrastructure.
7. World Economic Forum (WEF) Reports – EV adoption trends and future mobility.

Course: Electric Vehicle architecture Laboratory		
Unit	**Contents**	**Hrs**
1	Study of Vehicle Categories Classification: 2W, 3W, 4W, LCV, HCV, passenger cars, EV categories (L1–L7 as per CMVR). Hands-on observation in lab or workshop.	2
2	Automobile Familiarization Identify and study major components of a 2W/4W (brakes, steering, tyres, differential).	2
3	Differential Study Demonstration of differential working using cut-section model. Torque distribution and wheel speed demonstration.	2
4	EV Familiarization Study the layout of an Electric 2W/4W (battery, motor, controller, wiring harness).	2
5	Motor Demonstration Testing a BLDC/PMSM motor with controller and throttle.	2
6	Battery Basics Charging/discharging of a lithium-ion battery pack, SOC measurement.	2
7	EV Component Dismantling & Assembly (motor, controller, BMS).	2

VSEC: Introduction to Materials Modeling					
Course Code	MM(VS)-25001	**Examination Scheme**		Marks	
Teaching Scheme	1-0-2-1	**ESE**	30	**CIE**	50
Credits	2	**CIE**	20		

Course Outcome: the students will demonstrate the ability to:

1. Derive and apply statistical-mechanics relations (ensembles, partition functions) to compute material properties and predict structure–property trends in solids and polymers.
2. Formulate and solve thermodynamic equilibrium and phase-change problems—construct/interpret phase diagrams and evaluate stability using free-energy criteria for closed/open systems.
3. Select and justify appropriate modeling approaches (atomistic MD/DFT and continuum FEA) for a given materials problem, articulating assumptions, limits, and validation needs.
4. Implement and automate simulations using modern tools and manage the resulting data.
5. Analyze, visualize, and interpret datasets, quantify uncertainty, and produce good-quality reports/figures that defend evidence-based conclusions.

01. Statistical Mechanics and Thermodynamics: 6Hrs

Lattice models of structures, basics of quantum mechanics, hydrogen atom, energy minimization, molecular bonding, change of state and equilibrium, laws of thermodynamics, free energy, phase diagrams

02. Structure of Solids: 6Hrs

X-ray diffraction principle, Laue condition, Ewald construction, Bragg's law, powder diffraction, symmetries and tensors

List of Experiments/Assignments:

1. Generate and modify a crystal structure using VESTA's visualization tool.
2. Use VESTA to simulate the XRD pattern of different crystal structures.
3. Perform X-ray diffraction analysis and indexing of crystal structures in metals.
4. Perform electronic energy and k-point optimization of a Pt crystal using VASP (DFT).
5. Use VASP Predict lattice parameters of "X" element after electronic energy and k-point optimization.
6. Generate and visualize a polymer chain using LAMMPS (MD) and OVITO.
7. Perform energy minimization using the conjugate gradient function on a polymer chain using LAMMPS (MD).
8. Simulate molecular dynamics of a polymer chain under the canonical ensemble using LAMMPS (MD) and visualize the topology of the chain in OVITO.

Self-study 6Hrs

1. Install LAMMPS from https://www.lammps.org/download.html
2. Model a methane (CH_4) molecule and perform energy minimization.

Create an MD model of multiple polymer chains using the replicate command

Suggested learning resources:

- Engel, T., and P. Reid. Physical Chemistry. San Francisco, CA: Benjamin Cummings, 2005. ISBN: 9780805338423.
- Allen, S. M., and E. L. Thomas. The Structure of Materials. New York, NY: J. Wiley & Sons, 1999. ISBN: 9780471000822.

- Rohrer, G. Structure and Bonding in Crystalline Materials. New York, NY: Cambridge University Press, 2001. ISBN: 9780521663793.
- Atkins, P. W., and J. de Paula. Physical Chemistry. 7th ed. New York, NY: Oxford University Press, 2002. ISBN: 9780198792857.
- Dill, K. A., and S. Bromberg. Molecular Driving Forces. New York, NY: Routledge, 2002. ISBN: 9780815320517.
- Kittel, Charles. Introduction to Solid State Physics. 8th ed. New York, NY: J. Wiley & Sons, 2005. ISBN: 0-471-41526-X
- LAMMPS - a flexible simulation tool for particle-based materials modeling at the atomic, meso, and continuum scales, A. P. Thompson, H. M. Aktulga, R. Berger, D. S. Bolintineanu, W. M. Brown, P. S. Crozier, P. J. in 't Veld, A. Kohlmeyer, S. G. Moore, T. D. Nguyen, R. Shan, M. J. Stevens, J. Tranchida, C. Trott, S. J. Plimpton, Comp Phys Comm, 271 (2022) 10817. https://www.lammps.org/index.html

VSEC: MODERN CHEMICAL ANALYSIS					
Course Code	MM(VS)-25002	**Examination Scheme**			
Teaching Scheme	1-0-2-1	**ESE**	30	**CIE**	50
Credits	2	**CIE**	20		

Course Outcomes:

At the end of this course, students will be able to:
Understand the basic principles of different methods of chemical estimation.
Design and perform elemental analysis experiments from different materials
Perform and interpret results of analytical techniques.
Aware of different Indian Standards related to chemical analysis of Elements.

Syllabus:

Unit	Contents	Lectures
01.	**Fundamentals and Traditional Methods of Analysis:** Importance of chemical analysis in steels and alloys, Wet-chemical and gravimetric methods, Colorimetric and titrimetric techniques to determine elemental composition.	**06**
02.	**Modern Instrumental Methods and Standards:** Transition from classical to modern methods, Advantages: sensitivity, speed, multi-element analysis. Overview: Electro-gravimetry, FTIR, UV, surface coating analysis, Importance of Standardization and Indian Standards in Metallurgical Laboratories.	**06**

List of Experiments/Assignments: (Any 08 experiments)

1. Estimation of carbon in steels by colorimeter.
2. Analysis of Fe from the steel sample.
3. Analysis of Mn in steels & cast iron.
4. Analysis of Ni in steels & stainless steels.
5. Analysis of Cr in steels & stainless steels.
6. Analysis of Cu & Pb by Electro-gravimeter.
7. Analysis of Carbon in steel and Cast iron by using Strohlien's apparatus.
8. Analysis of Ni/Cu by Atomic Absorption Spectroscope.
9. Analysis of compounds by using FTIR/ UV Spectroscopy.
10. Estimation of mass of Zinc on the steel plate.
11. Study of FIVE Indian Standards related to the chemical analysis of Elements.

Suggested learning resources:

1. S.P.Jain & B.C.Agarwal, A textbook of Metallurgical Analysis, 8th ed., Khanna Publishers, New Delhi, 2009.
2. Dean J.A., Merritt L. L., Settle F.A., Williard H.H., Instrumental methods of Analysis 7th edition, CBS Publishers & Distributors, New Delhi,2009.
3. Vogel, Quantitative Inorganic Analysis, 7th edition, PEARSON EDUCATION, Prentice hall,2010

VSEC: Manufacturing Practices and Fab Lab- I (MPF-I)					
Course Code	MFG(VS)-25001	**Examination Scheme**			
Teaching Scheme	1-0-2-1	**MSE**	--	**CIE**	50
		CIE	20		
Credits	2	**EIE**	30		

Course Outcomes:

1. To make students understand different tools & equipment used in workshop practices.
2. To acquire knowledge and skills for crafting various carpentry, fitting, and welding projects.
3. To impart safety measures in the workshop.
4. To Enhancing skills for task-oriented applications.
5. To showcase the process of PCB manufacturing.

Module I: Introduction and demonstration:	**[02 Hrs]**
Familiarization with different workshop areas and adherence to safety regulations within a workshop setting.	
Module II: Carpentry shop:	**[02 Hrs]**
Introduction to tools and their functions, wood varieties and their respective uses, carpentry hardware types and their applications, carpentry joints, as well as operational techniques including marking, sawing, planning, chiseling, grooving, boring, joining, along with a discussion on various wood types and carpentry hardware.	
Module III: Fitting shop:	**[02 Hrs]**
Overview of tools and procedures, varieties of marking tools and their applications, types of cutting tools for fitting and their uses, fitting tasks including chipping, filing, scraping, grinding, sawing, marking, drilling, and tapping. .	
Module IV: **Introduction and demonstration:**	**[02 Hrs]**
Machine shop: Overview of machine tools and their operations, showcasing fundamental machinery such as lathe, shaper, drilling milling machines and an introduction to the basics of CNC machines.	
Module V: Metal joining shop:	**[02 Hrs]**
Presentation of tools and various welding joint techniques, including arc welding, gas welding, and gas cutting.	
Module VI: PCB Printing:	**[02 Hrs]**
Comprehending the procedures involved in creating printed circuit boards (PCBs), chemical etching PCBs, and CNC mini milling for PCB production.	

Upon completion of this course, students will be able to:

1. Learn and apply the functions of machine tools.
2. Choose the correct tools needed for tasks.
3. Engage in creating components using various workshop skills like fitting, carpentry, and welding.
4. Recognize and utilize the right tools for machining techniques such as facing, thread cutting, and tapping.

VSEC: Robotics and Drone Operation and Safety						
Course Code	MFG(VS)-25002		**Examination Scheme**			
Teaching Scheme	1-0-2-1		**ESE**	30	**CIE**	50
Credits	2		**CIE**	20		

Course Outcomes: At the end of course, students will be able to

- Understand basics of Robots, its elements, structure and classification
- Select the sensors, drives, grippers for robots
- Understand programming of Robot
- Understand basics of drone, its classification and operations
- Identify drone elements
- Understand Drone Safety Guidelines and Regulations

Unit 1: Basics of Robotics **06 Hrs**

Introduction to Drones: History and Evolution, Components of a Drone, Types of Drones: Quadcopters, H
Octocopters, Fixed-Wing, Drone Flight: Lift, Thrust, Drag, and Weight, Zone Classifications for Drone O
Drone Sensors: Obstacle Avoidance, Altitude Hold, Remote Controllers: Functions and Controls, Camera Settings, Types of Drone communications, Unmanned aerial systems

Unit 2: Drone Operations Safety **06 Hrs**

Introduction to Drones: History and Evolution, Components of a Drone, Types of Drones: Quadcopters, Hexacopters, Octocopters, Fixed-Wing, Drone Flight: Lift, Thrust, Drag, and Weight, Zone Classifications for Drone Operations,
Drone Sensors: Obstacle Avoidance, Altitude Hold, Remote Controllers: Functions and Controls, Camera Settings, Types of Drone communications, Unmanned aerial systems
Drone Navigation Systems: GPS, Drone Cameras: Types, Resolution, and Settings, Video encoding standards: PAL & NTSC and their relevance to drone operations in different regions.
Drone Battery Management: Charging, Storage, and Safety
Drone Applications: Photography/Videography, Agriculture, Search and Rescue, combat drone
Drone Pre-flight Checklists and Procedures, Safety Guidelines and Regulations

Reference Books:

1. Peter Corke , Robotics, Vision, and Control: Fundamental Algorithms in MATLAB, Springer,2020
2. Mataric, Maja J. *The robotics primer*. MIT press, 2007.
3. Lynch, Kevin M., and Frank C. Park. *Modern robotics*. Cambridge University Press, 2017.
4. Sachi Nandan Mohanty, J.V.R. Ravindra, G. Surya Narayana, Chinmaya Ranjan Pattnaik, Y. Mohamed Sirajudeen, Drone Technology: Future Trends and Practical Applications, 2023
5. Mr. I. V. S. Yeswanth, Dr. A. V. S. Sridhar Kumar, Fundamentals of Drone Technology: Drones-The future of 21st century, 2024
6. Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, 2021 John Wiley & Sons, Inc.
7. Terry Kilby and Belinda Kilby, “Make: Getting Started with Drones “, Maker Media, Inc,
8. John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016
9. Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.

Laboratory Experiments:	
	1. Demonstration and understanding and working of Robot elements 2. Demonstration of ABB Robot, Niryo Robot, mobile robot 3. Model building for robots based on geometry 4. Programming of Niryo Robot 5. Demonstration of elements of Drone 6. Demonstration of Drone sensors and their working 7. Demonstration of Drone Navigation Systems: GPS, Drone Cameras 8. Operating a Drone, Pre-flight Checklists and Procedures, Safety Guidelines and Regulations

PCC-2: Self-Awareness and Personality Development		
Course Outcomes:		
1	REMEMBERING	Self-Awareness principles
2	UNDERSTANDING	Understand learning effectively in self-awareness
3	APPLYING	Applying the principles self-awareness
4	ANALYSING	Analyze the principles of self awareness
5	EVALUATING	Evaluate through various methods effectively like SWOT
6	CREATING	Creatively apply the self-awareness to attain highest potential
*** Use any of the verbs as starting of CO statement from blooms taxonomy as per cognitive abilities level.		

Unit 1: Orientation

Session 1.1: Knowing Yourself

- Definition and importance of self-awareness
- Tools for self-assessment (SWOT Analysis, identifying blind spots)

Session 1.2: Exploring Personal Values and Beliefs

- Identifying core values and beliefs, decision-making and behavior
- Aligning personal values with professional goals
- Exercises

Unit 2: Personality Development

Session 2.1: Nature vs Nurture

Traits vs Behaviors

Growth vs Fixed Mindset

Role Of environment, habits & choices

Session 2.2: Building Emotional Intelligence (EQ vs Intelligent Quotient)

- Introduction to emotional intelligence (EI)
- Identifying emotions, EQ vs IQ differences
- Empathy, perspectives, emotions under stress
- Developing EI for personal and professional success

Exercises

Unit 3: Communication Essentials

Session 3.1: Fundamentals of Effective Communication

- Verbal, non-verbal, and written communication skills
- Active listening and empathy in communication
- Barriers to effective communication and overcoming them
- Exercises

Session 3.2: Introduction to Mind Mapping

- What is mind mapping? Understanding the concept
- Benefits of mind mapping for learning and personal development
- Tools and software for creating mind maps

Session 3.3: Applying Mind Mapping Techniques

- Practical exercises: Creating mind maps for problem-solving and decision-making

- Using mind mapping for goal setting and planning

Unit 4: Character Building (6 Hours)

Session 4.1: Strategies for Character Building (2 Hours)

- Habits and Attitude: Components of Personality
- Confidence vs arrogance
- Identifying self-limiting beliefs and overcoming them
- Stage fear & self-doubts
- Building positive relationships
- Power of positive self-talk

Session 4.2: Goal Setting and Personal Development Planning (2 Hours)

- SMART goals for personal and professional growth
- Creating a personal development plan

Tracking progress and staying motivated

Unit 5: My Growth Path

Vision

- Creating and aligning plan with values
- Identifying time wasters
- Building resilience & adaptability, balancing academics, social life & self-care
- Personal branding and digital presence, handling social media responsibly Exercise:

Textbooks:

Managing Career by Discovering Your personality by S. Chand by S. Chand Publication

Reference Books:

- Self-Awareness: The Hidden Driver of Success and Satisfaction by Travis Bradberry
- You can heal your life-Louise Hay
- HBR- On Managing Yourself

Communication Skills			
Course Code	AS(AE)-25001	**Examination Scheme**	
Teaching Scheme	0-0-2-0	**CIE**	100
Credits	1		

Course Outcomes: students will be able to:

1. Recall and use basic language skills –listening, speaking, reading, and writing and attempt the tasks using grammar and vocabulary efficiently
2. Understand the concepts/ principles of communication skills and structured conversations effectively
3. Develop the knack to make their points of view clear to the audience and portray their learning well in front of a large audience on a variety of relevant situations Analyze, apply, and present themselves competently in all formal spheres

01.Foundation of Language Learning Skills & Communication Skills	**4 Hrs**

English as a Global Language: Varieties of English
Basics of Communication Skills, 7 Cs of Effective Communication
Receptive Skills: Listening and Reading; Productive Skills: Speaking and Writing; Grammaticality and Appropriateness; Vocabulary Development

02.Listening Skills	**4Hrs**

Stages of Listening (pre, while and post), Strategies to Develop Active Listening Skills, Problem Sounds

03.Speaking Skills	**4 Hrs**

Oral Communication, Sounds in English, Pronunciation, Stress, Intonation and Pauses, Formal and Informal Expressions, Situational Conversations, Group Discussion, Presentation Skills

04.Reading and Writing Skills	**2 Hrs**

Reading Techniques: Scanning, Skimming and Active Reading; Common Problems in Reading; Stages of Writing (pre, while and post); Letter/ Email writing- drafting, editing, summarizing, proofreading

05Indian Knowledge System:	**Self-Study**

Philosophical Foundations of Speech, the four levels of speech (*Para*, *Pashyanti*, *Madhyama*, *Vaikhari*
The Art of Dialogue: The principles of *Samvāda* (dialogue) from the Upanishads, emphasizing mutual respect, deep listening The Rasa Theory

Suggested learning resources:

1. Communication Skills for Engineers by S. Mishra & C. Muralikrishna (Pearson)
2. Communicative English for Engineers by N. Bhatnagar & M. Bhatnagar (Pearson)
3. Effective Communication and Soft Skills by N. Bhatnagar & M. Bhatnagar (Pearson)
4. English for Engineers by Sudarshana, N.P. and Savitha, C. (CUP)
5. Cambridge English for Engineering by M. Ibbotson (CUP)
6. Essential English Grammar (Elementary & Intermediate) Raymond Murphy (CUP)
7. Communication for Business: A Practical Approach by Shirley Tailor (Longman)
8. Business Correspondence and Report Writing, R. C. Sharma & Krishna Mohan (Tata McGraw Hill.

Fundamentals of Artificial Intelligence *(Mandatory for CSE and AIML Students)*						
Course Code	CTS-25001		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**MSE**	30	**CIE**	100
Credits	3		**CIE**	20		
			ESE	50		

Course Outcomes: Students will be able to:

1. **Understand the fundamentals of Artificial Intelligence and its evolution.**
2. **Apply AI techniques for problem-solving and searching in simple domains.**
3. **Comprehend the basics of Machine leaning and their working principles.**
4. Recognize ethical and responsible AI practices.

Unit 1:	**Introduction**	**[5 Hrs]**

The Foundations of Artificial Intelligence, The History and Evolution of Artificial Intelligence, The State-of-the-Art: Models, Agents, Agentic AI, Hype vs Reality, Day-to-day interactions with AI (chatbots, voice assistants, banking, healthcare, agriculture), Types of AI: rule-based systems, learning-based systems, Neural Networks, Reinforcement Learning, generative AI.

Unit 2:	**Solving Problems by Searching** and Natural Language Processing	**[5 Hrs]**

Problem Solving Agents, Uninformed Search, Informed Search, Introduction to Heuristic Search, Heuristic Function.
Introduction to NLP, Search driven by Word2Vec, Search driven by BERT transformer model.

Unit 3:	**Machine Learning** and GenAI	**[4Hrs]**

Classification and Prediction: Basics of Machine Learning, Supervised and Unsupervised Learning, predicting numerical outcomes using Linear Regression, Classification using Decision Trees, and K-Means Clustering. Basic evaluation of classification models using accuracy and confusion matrix.
GenAI and Prompting: GenAI evolution, Training, Prompting and Fine tuning, Hugging Face and Ollama

Unit 4:	**AI Ethics and Responsible AI**	**[4Hrs]**

Bias, Fairness, Data Privacy, Explainability, Sustainability, GenAI usage

Textbooks:

[1]	Russell, S. & Norvig, P. (2020), Artificial Intelligence: A Modern Approach, 4th Ed. Pearson.
[2]	Perry Xiao (2022), Artificial Intelligence Programming with Python, First Edition, Wiley

Reference Books:

[1]	David L. Poole, Alan K. Mackworth, “Artificial Intelligence: Foundations of Computational Agents”, Third Edition, 2023, Cambridge University Press.
[2]	Sutton, R. S., & Barto, A. G. (2018). Reinforcement Learning: An Introduction. (2nd ed.). A Bradford Book.

Web Resources:

[1]	Stanford Course webpage: https://stanford-cs221.github.io/spring2024/
[2]	Barckley Course webpage: https://inst.eecs.berkeley.edu/~cs188/su25/
[3]	MIT Course web page: https://ocw.mit.edu/courses/6-034-artificial-intelligence-fall-2010/pages/syllabus/
[4]	NPTL Course webpage: https://nptel.ac.in/courses/106102220
[5]	Coursera: Andrew Ng's courses on Machine Learning and Deep Learning: https://www.coursera.org/specializations/machine-learning-introduction

[6]	Papers with Code: A repository of academic papers with corresponding code implementations: https://paperswithcode.com/
[7]	TensorFlow Official Website: Excellent documentation and tutorials for the leading Deep learning framework: https://www.tensorflow.org/
[8]	PyTorch Official Website: Excellent documentation and tutorials for the leading deep learning framework: https://pytorch.org/
[9]	Google AI: Research and education resources from Google's AI team: https://cloud.google.com/ai
	List of Experiments/Assignments:
[1]	Introduction to AI Tools & Python
[2]	Heuristic Search: Illustrate A* algorithm with different heuristics on an 8-puzzle problem.
[3]	Illustrate Breadth-First Search (BFS) and Depth-First Search (DFS) for simple graph traversal or pathfinding in a small maze.
[4]	Illustrate Minimax algorithm for Tic-Tac-Toe with a simple AI opponent.
[5]	Demonstrate the difference between supervised and unsupervised learning using a small dataset
[6]	Illustrate Decision Tree Classifier using Iris Dataset.
[7]	Illustrate Linear Regression with small data set (e.g., predicting student marks vs. hours studied).
[8]	Illustrate K-Means Clustering on Iris Dataset on a small dataset (e.g., Iris dataset) and visualize the clusters using 2D plots. Analyze the results for different values of K.

[ES-01] Fundamentals of Electrical Engineering						
Course Code			**Examination Scheme**			
Teaching Scheme	2-0-2-1		**MSE**	30	**CIE**	100
Credits	2		**CIE**	20		
			ESE	50		

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Analyze AC and DC circuits
2. Apply the principles of electric and magnetic circuits to solve engineering problems
3. compute the efficiency and regulation of a single-phase transformer
4. select motors for specific industrial applications
5. use relevant protective devices for electrical installations measure various quantities by using common electrical measuring instruments

Unit 1: DC Circuits: **(3 hrs)**

Electrical circuit elements (R, L, and C), voltage and current sources, Kirchhoff's laws, analysis of simple DC circuits: Superposition, Thevenin and Norton theorems, Maximum Power Transfer theorem, Star-Delta transformation, DC transient in series RC, RL, parallel RC, RL circuits.

Unit 2: AC Circuits: **(3 hrs)**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, R-L, R-C, R-L-C combinations, series resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections, three-phase power, concept of electric grid

Unit 3 : Magnetic Circuits and Transformers: **(2 hrs)**

Magnetic materials, B-H curve, hysteresis loop, series and parallel magnetic circuits, ideal and practical transformer, equivalent circuit, losses in transformers, regulation, and efficiency. Autotransformer and three-phase transformer connections

Unit 4: Electrical Measurements and Instruments: **(2 hrs)**

Construction and working principle of- (1) moving coil, moving iron, dynamometer type instruments. (2) Wattmeter, energy meter. Measurement of power and energy in single-phase and three phase circuits, energy bill calculation.

Unit 5: Electrical Installation and Safety: **(2 hrs)**

Types of wires and cables, Copper conductor sizes and rating, earth wires, Switch Fuse Unit (SFU), Miniature Circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB), Lightning protection. Types and characteristics of Batteries, elementary calculations for energy consumption, and battery backup, inverter, UPS types and specifications

Textbooks:

- D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2nd Edition 2019
- D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 4th Edition, 2019E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2010

Reference Books:

- Vincent Del Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 2nd Edition, 2015.
- L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2nd Edition, 2003.

Fundamentals of Electrical Engineering: Laboratory

Experiments:

1. Overview of the Basic Electrical Engineering Lab (Equipment available: universal trolley, meters, transformers, loads, etc.) and safety precautions.
2. Verification of Network Theorems:
3. Connect a simple DC circuit with two loops and more than one source and measure all the branch currents and node voltages.
4. Solve the same circuit applying Thevenin's, Norton's, and Superposition Theorems.
5. Measure the voltage, current, and power in the R-L, R-C, and R-L-C series circuits and observe the phase difference between voltage and current using CRO.
6. Connect the three-phase induction motor in star and delta and measure the line and phase voltages and currents to verify the relationship between line and phase quantities.
7. Evaluation of Relative permeability and Magnetic reluctance of a 3-Limb core using an exciting coil of unknown number of turns.
8. Flux diversion in the 3-Limb core by generating circulating currents in short-circuited conductor loop placed around the central limb.
9. Determine the efficiency and regulation of a single-phase transformer by direct loading.
10. To determine the energy consumed by the given load.
11. Calibration and Testing of single phase energy Meter.
12. Measurement of 3 phases reactive power with single –phase wattmeter for balanced loading.
13. Measurement of power by 3-voltmeter and 3-Ammeter methods.

Elements of Electronics Engineering						
Course Code	ET-25001		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**MSE**	30	**CIE**	100
Credits	3		**CIE**	20		
			ESE:	50		
Course Outcomes: Students will be able to:						

1. Understand and explain the fundamentals of cyberspace, cybercrime, types of cybercriminals, and the legal perspective with reference to the Indian IT Act, 2000.
2. Apply computer networking concepts such as TCP/IP protocols and the OSI model, and identify vulnerabilities related to passwords and steganography techniques.
3. Analyze ethical hacking practices by differentiating types of hacking and hackers, understanding the phases of ethical hacking, and utilizing tools such as NMAP, Metasploit, and Burp Suite for penetration testing.
4. Implement cryptographic techniques including symmetric and asymmetric encryption, hashing, and digital signatures to ensure confidentiality, integrity, authentication, and non-repudiation.

Unit 1: Introduction to Cybersecurity	**[3 Hrs]**

Introduction to Cyberspace, Need for Cybersecurity, Cyber Crime: Definition and origin of the term: Cyber Crime and Information Security, Cybercriminals, CIA triad (Confidentiality, Integrity, Availability), Classification of Cyber Crimes, Legal Perspective of Cyber Crime, Indian IT Act, 2000.
Self-Learning Topic: Types and Classification of Cybercrimes with Case Studies in India

Unit 2: Basics of Computer Networking	**[3 Hrs]**

Basic concepts of computer networks, including TCP/IP protocols, the OSI model, and network architectures. Introduction to Steganography: hiding information in files. Introduction to password protection methods and common attacks such as brute force and dictionary attacks. Learn simple ways to keep passwords secure.
Self-Learning Topic: Understanding Password Attacks and Prevention

Unit 3: Introduction to Ethical Hacking	**[3 Hrs]**

Definition of hacking, Ethical Hacking, Importance of Ethical Hacking, Types of Ethical Hacking, Types of Hackers, Concepts and Phases of System Hacking, Phases of Ethical Hacking, Overview of tools: NMAP, Metasploit, Burp Suite (conceptual understanding), Ethical Hacking Process.
Self-Learning Topic: Overview of Ethical Hacking Tools and Their Use

Unit 4: Introduction to Cryptography	**[3 Hrs]**

Definition and Components of Cryptography, Types: Symmetric and Asymmetric Cryptography, Cryptographic Principles: Confidentiality, Integrity, Authentication, Non-repudiation, Hashing Techniques, Digital Signatures, Types of Attacks.
Self-Learning Topic: Cryptography in Everyday Life

Textbooks:

[1]	Nina Godbole and SunitBelpure, Cyber Security Understanding Cyber Crimes,Computer Forensics and Legal Perspectives,Wiley
[2]	V. K. Pachghare, “Cryptography and Information Security”, 3rd edition, PHI Learning, ISBN: 978-93-893-4710-4.

Reference Books:

[1]	Graham, J., Howard, R., & Otson, R. (2010). Cyber security essentials. CRC Press.
[2]	Wu, C.-H., & Irwin, J. D. (2013). Introduction to cyber security. CRC Press, Taylor & Francis Group.

Elements of Electronics Engineering Laboratory
Course Outcomes: At the end of the course, students will demonstrate the ability to 1. Design basic circuits using diodes. (BL3) 2. Identify and characterize basic devices such as BJT and FET from their package information by referring to manufacturers' data sheets. (BL1, BL2) 3. Design, simulate, built and debug simple combinational circuits using gates. (BL3)
List of Experiments: 1. Introduction to various electrical passive components such as Resistors, inductors and capacitors, introduction to active components, introduction to breadboard, Measurement of resistance using the colour code, series and parallel connection of the resistances and its implementation on breadboard. Exposure to usual electronic equipment/instruments such as Multi-meter, Oscilloscope, Function generator, Power supply. 2. To Design clipping circuits - Single ended clipping, Double ended clipping, and clamping circuits. 3. To observe the effect of Variation of Frequency and Load Regulation for Voltage Multiplier. 4. To observe the output voltage of a half wave rectifier and center tapped full wave rectifier with and without capacitor filter. Calculate V_{dc} and I_{dc}. 5. To observe Input and Output Characteristics of BJT in CE configuration and Find h parameters from characteristics. 6. To observe output of single stage BJT CE amplifier and Find R_i, R_o and A_V. 7. To simplify and implement a Boolean function using k -map technique e.g. code converter 8. To design and implement logic using Multiplexers and Demultiplexer.

Fundamentals of MATLAB and Simulink						
Course Code	IE-25001		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**MSE**	30	**CIE**	100
Credits	3		**CIE**	20		
			ESE	50		

Course Outcomes: students will be able to:

1. Demonstrate an understanding of the MATLAB environment, basic syntax, workspace management, data visualization, numerical computations, and solution of mathematical problems using MATLAB
2. Apply MATLAB programming constructs (arrays, functions, control statements) for problem solving in engineering and science.
3. Develop and analyze dynamic system models using Simulink block diagrams.
4. Simulate, test, and interpret results for control, signal processing, and engineering applications in MATLAB/Simulink**.**

Unit 1:	**Basics of MATLAB:**	**[5 Hrs]**

Introduction to MATLAB environment (workspace, command window, editor), Variables, constants, and data types, Basic mathematical operations, Arrays, vectors, and matrices, MATLAB functions, scripts, and live scripts.

Unit 2:	**Programming in MATLAB:**	**[4 Hrs]**

Control structures: if, for, while, switch, User-defined functions, File input/output, Debugging and error handling, Introduction to symbolic toolbox, Mathematical modeling of dynamic systems, Continuous and discrete-time systems, Simulation of mechanical and electrical systems, output response and analysis.

Unit 3:	**Data Visualization & Numerical Methods**:	**[5 Hrs]**

2D plotting: line, bar, scatter, pie, 3D plotting and surface visualization, Curve fitting and interpolation, Numerical differentiation and integration, Solving linear and nonlinear equations, Ordinary differential equations (ODEs)

Unit 4:	**Introduction to Simulink:**	**[4 Hrs]**

Simulink environment, blocks, libraries, and models, Building basic block diagrams, Sources, sinks, and subsystems, Simulation control and solver settings, Signal routing and data visualization (Scope, Display), modeling of dynamic systems.

Textbooks:

- **Holly Moore,** *MATLAB for Engineers*, 6th Edition, Pearson, 2023.
- **Amos Gilat,** *MATLAB: An Introduction with Applications*, 6th Edition, Wiley, 2023.
- **Rudra Pratap,** *Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers*, 1st/2nd Edition, Oxford University Press.
- **Stephen J. Chapman,** *MATLAB Programming for Engineers*, 6th Edition, Cengage Learning, 2019Russell, S. & Norvig, P. (2020), Artificial Intelligence: A Modern Approach, 4th Ed. Pearson.

Reference Books:

- **Stormy Attaway*, MATLAB: A Practical Introduction to Programming and Problem Solving*, 6th Edition, Butterworth-Heinemann, 2023.**
- **Kwon & Bang, *The Finite Element Method using MATLAB*, CRC Press.**

- **Hanselman, D. & Littlefield, B., *Mastering MATLAB*, Pearson.**
- **S. N. Sivanandam & S. N. Deepa, *Introduction to MATLAB with Applications*, McGraw Hill.**

List of Experiments/Assignments:

- **Introduction to MATLAB Environment** – Familiarization with MATLAB interface, command window, workspace, and editor.
- **Basic Operations** – Scalars, vectors, matrices, and array manipulations.
- **Script and Function Files** – Writing user-defined functions and scripts.
- **Control Structures** – Use of if, for, while, and switch statements with simple applications.
- **Data Visualization (2D)** – Plotting line graphs, bar charts, pie charts, and multiple plots.
- **3D Plots and Surface Visualization** – Mesh, contour, and surface plots.
- **Numerical Methods** – Solving equations, interpolation, differentiation, integration.
- **ODE Solvers** – Solving ordinary differential equations using ode45 and comparison with analytical results.
- **Introduction to Simulink Environment** – Exploring blocks, libraries, and model creation.
- **Basic Simulations** – Using sources, sinks, and mathematical blocks.
- **Signal Routing and Visualization** – Use of Mux, Demux, Scope, and Display blocks.
- **Modeling of Dynamic Systems** – Simulation of first-order and second-order systems.
- **Transfer Function and State-Space Models** – Implementing and analyzing responses in Simulink.
- **Continuous and Discrete Systems** – Simulation using integrators and discrete blocks.

Essentials of Civil Engineering					
Course Code	CE-25001	**Examination Scheme**			
Teaching Scheme	2-0-2-1	**MSE**	30	**CIE**	100
Credits	3	**CIE**	20		
		ESE	50		

Course Outcomes: students will be able to:

1: Demonstrate different terminologies related to Civil Engineering.

2: Select suitable structural component or structure, services in a particular situation.

3: Apply the various concepts of environmental engineering in practice.

4: Assess suitability of material or type of foundation in a particular situation.

Unit 1 Introduction **to Civil Engineering** **[8Hrs]**

Role of Civil Engineer in the construction of buildings, dams, expressways and infrastructure projects for 21st century. Importance of an interdisciplinary approach in engineering. b) Basic Areas in Civil Engineering Surveying, Construction Engineering, Project Management, Transportation Engineering, Fluid Mechanics, Irrigation Engineering, Structural Engineering, Geotechnical and Foundation Engineering, Environmental Engineering, Quantity Surveying, Earthquake Engineering, Infrastructure Development, Town Planning, Remote Sensing.

Unit 2 Building Materials & Built Environment Planning **[8Hrs]**

Types of buildings and classification as per occupancy and fire-resistance Components of buildings: Foundation, Walls, Floors, Roofs, Doors, Windows, Staircases, Finishes, Basics of building planning, orientation, ventilation, and lighting Green buildings and energy-efficient construction practices Classification and properties of common construction materialsConcept of an integrated built environment-natural and manmade. Principles of planning, viz. Aspect, Prospect, Roominess, Grouping, Privacy, Circulation, Sanitation, Orientation, Economy. Role of by-laws in regulating the environment. b) Use of various eco-friendly materials in construction. Concept of green buildings.

Unit 3 Surveying **[8Hrs]**

Meaning and scope of surveying, importance in engineering Objectives of Surveying, Types of Surveying, basic surveying instruments and their uses, role of surveying in modern technology (GIS, GPS, drones).

Unit 4 Advancements in Civil Engineering **[8Hrs]**

Structural marvels and their importance in human civilization, Historical and Modern Structural Wonders in Civil Engineering, Case Studies (Short videos/documentaries of construction marvels, Interdisciplinary nature of great structures (mechanical systems, electrical installations, material science, computing, etc.).

Text Books:

1. 2. 3. 4. 5. 6. 7. 8. 9. 10.	Arora S. P. and Bindra S.P., “Building Construction”, Dhanpat Rai and Sons, Delhi. Duggal S.K., “Surveying”, Volume I, Tata Mc Graw Hill Publishing Company Limited New Delhi, Edition 2013 Rajvir Singh, "Watershed Planning and Management”, Yash Pulishing House, Jaipur, India 3rd Edition 2016 Punmiya B.C., A.K.Jain and Ashok kumar Jain, “Soil Mechanics and Foundations”, Laxmi Publications Pvt Ltd, New Delhi Shah, Kale and Patki, “Building Design and Drawing”, Tata Mc Graw Hill, New Delhi K.A.Patil and I.K.Pateriya, “Basic Civil Engineering”, Shree Laxmi Prakashan, Aurangabad. Garg S.K. “Water Resources Engineering, Volume I”, Khanna Publishers, New Delhi Garg S.K. “Water Resources Engineering, Volume II”, Khanna Publishers, New Delhi Punmiya B.C., Ashok kumar Jain and A.K. Jain, “Water Supply Engineering”, Laxmi Publications Pvt Ltd, New Delhi Punmiya B.C., Ashok kumar Jain and A.K. Jain, “Waste Water Engineering and Air Pollution”, Laxmi Publications Pvt Ltd, New Delhi

Reference Books:

1. E.M. Tideman," Watershed Management: Guidelines for Indian Conditions", Omega Scientific Publishers.
2. Sushil Kumar, "Building Construction", Standard Publishers Distributors, Nai Sarak Delhi.

Laboratory Assignments (Any Five)

1. Study of any 4 types of maps and writing their uses.
2. Introduction to different surveying instruments like dumpy level, auto level, Theodolite, EDM, lasers, total station
3. Determination of coordinates of a traverse using Global Positioning system (GPS)
4. Visit to a construction site for studying the various construction materials used, type of structure, type of foundation and components of superstructure – submission of visit report.
5. Demonstration of use of any 4 Civil Engineering software’s.
6. Making a poster (Full imperial sheet size) in a group of 4 students, related to Energy/Environment.
7. Presentation in a group of 4 students, any case study related to Civil Engineering/Energy/Environment.
8. Classroom activities Model-making (paper bridges, domes) Design and construct small-scale models using only paper and basic stationery

Course Title: Systems in Mechanical Engineering					
Course Code	ME-25001	**Examination Scheme**			
Teaching Scheme	2-0-2-1	**MSE**	30	**CIE**	100
Credits	3	**CIE**	20		
		ESE	50		

Course Outcomes: students will be able to:

1.	To understand the fundamental concepts of mechanical engineering.
2.	To develop basic knowledge of thermodynamic laws and apply them in energy conversion devices.
3.	To develop understanding of constructional details and working principles of energy conversion devices.
4.	To develop the basic knowledge about power transmission elements, machine tools and manufacturing processes

Unit 1: **Introduction to Thermodynamics**	**(4 Hr)**
Basic Concepts: Thermodynamic system, Equilibrium etc. Thermodynamic work and Heat, I and II Laws of thermodynamics and their applications in Engineering, Heat Engine, Refrigerator and Heat pump, Carnot Principle.	
Unit 2: Energy Conversion Devices	**(5Hr)**
Introduction to Steam turbine, Gas turbine, Hydraulic turbines, Two Stroke and Four stroke I.C. engines (Petrol and Diesel),Reciprocating Compressor, Reciprocating and Centrifugal pump, (Elementary treatment only), Vapour Compression Refrigeration Cycle, Study of household refrigerator.	
Unit 3: Machine elements	**(4Hr)**
Power transmission shafts, axles, keys (types and constructional features), Bearings: Purpose, Classification, Sliding contact bearing: Solid journal bearing, Bush bearing, Rolling contact bearing: Ball bearing, Roller bearing. Power Transmission Devices (basic elements, constructional features): Belt drive: Flat and V belt drive, Open and Cross belt drive, Chain drive, Gear drives: Spur gear, Helical Gear, Spiral Gear, Bevel Gear, Worm and Worm Wheel, Rack and Pinion, Couplings: Rigid Coupling: Muff coupling, Flange Coupling, Flexible Coupling: Universal Coupling.	
Unit 04. Introduction to Manufacturing	**(5Hr)**
Machine tools: Lathe machine, Drilling Machine, Milling machine (Basic elements, Working Principle and operations). Manufacturing processes: Casting: Pattern making, Moulding, Forging, and metal joining processes: Welding, Soldering, Brazing.	

1. Understand the basic concepts and application of Thermodynamics.
2. Apply laws of Thermodynamics to various energy conversions devices
3. Understand power transmission elements and identify their suitability for various industrial power transmitting applications.
4. Select manufacturing processes suitable to produce components.

Suggested learning resources:

1. P. K Nag, “Engineering Thermodynamics”, Tata McGraw-Hill Publishing Co. Ltd, 2005

2. Hajra Choudhary, “Elements of Workshop Technology”, Media Promoters and Publishers Pvt. Ltd, 2010
3. Rajput, R.K., (2007), “Basic Mechanical Engineering”, Laxmi Publications Pvt. Ltd
4. Agrawal, Basant and Agrawal, C. M.,“Basics of Mechanical Engineering”, John Wiley and Sons, USA, 2008.
5. Yunus A. Cengel& Boles, “Thermodynamics “,Tata McGraw-Hill Publisher Co. Ltd., 2001
6. Arora and Domkunwar, “Thermal Engineering”, Dhanpat Rai and Sons., 2009
7. Rayner *Joel,* Basic Engineering T*hermodynamics,* Pearson Education, 2008
8. V. B Bhandari, Design of machine elements, Tata McGraw-Hill Publisher Co. Ltd., 2010 Tata McGraw Hill publisher Co. Ltd., 2017
9. Ganeshan, V., Internal Combustion Engines, McGraw HillPublisher Co. Ltd., 2018

Course Title: Systems in Mechanical Engineering Laboratory
Course Outcomes:
1. To understand the fundamental concepts of mechanical engineering. 2. To develop understanding of constructional details and working principles of energy conversion devices. **3.** To develop the basic knowledge about power transmission elements, machine tools and manufacturing processes.
Laboratory Work:
Demonstration / Study / Discussion on the following systems to be completed by every student 1. Energy conversion devices (any TWO) 2. Internal Combustion (IC) engine (4 Stroke / 2 Stroke / Petrol / Deisel) 3. Machine elements (key, shaft, bearing etc.) 4. Power transmission devices (gear, belt, chain, coupling etc.) 5. Working of machine tools (any TWO) 6. Recent trends in automotive industry 7. Conventional and non-conventional energy sources and power plants (any THREE) 8. Working of Computer Numerical Controlled (CNC) machine 9. Understanding of Industrial Robotics and its applications 10. Automation of manufacturing systems
Course Outcomes:
1. Develop the understanding of thermodynamics laws and apply to various energy devices 2. Utilize the knowledge obtained in theory to identify mechanical elements and devices. 3. Identify and select suitable manufacturing operation for component manufacturing.

ESC: Structure and Properties of Materials (Theory)					
Course Code	MT-25001	**Examination Scheme**			
Teaching Scheme	2-0-2-1	**MSE**	30	**CIE**	100
Credits	3	**CIE**	20		
		ESE	50		

Course Outcome: students will be able to:

At the end of this course, students will be able to:

1. Understand basic structure of engineering materials.
2. Understand theoretical basis of mechanical, electrical, magnetic, optical, thermal and dielectric properties.
3. Analyze, interpret and solve materials design problems.
4. Correlate structure of materials with their properties

Unit 01:	**05 Hr**

Classification of engineering materials, levels of structure, structure-property relationships in materials, Space lattice, metal structures, unit cells, Metallic structures: FCC, BCC and HCP, crystallographic directions and planes, Miller indices, single crystal, polycrystalline materials, anisotropy and non-crystalline solids, linear and planar densities, polymorphism and allotropy.

Unit 02:	**04 Hr**

Crstal Defects: Point, line, planar and surface imperfections, atomic vibrations, screw and edge dislocations, mixed dislocations, energy of dislocations, the force required to move dislocation and multiplication of dislocations, elastic behavior, slip systems, critical resolved shear stress and schmid's law

Unit 03:	**04 Hr**

Mechanical Properties: Engineering and true stress strain diagrams, yield and tensile strength, compression and shear strength, ductility and brittleness, hardness, stiffness, resilience, toughness, fatigue and creep resistance, ductile and brittle fracture, transition temperature, Material testing standards, Non-destructive testing

Unit 04:	**05 Hr**

Electrical, optical and Thermal properties: Resistivity range, the free electron theory, conduction by free electrons, energy gap in solids, magnetic moments due to electron spin, ferromagnetism and related phenomena, dielectric properties. Refractive index, reflectance, transparency, translucency and opacity, colour and luminescence, heat capacity, thermal expansion, thermal conductivity and thermal shock.

Text Books:

- V. Raghavan, "Materials Science and Engineering", Prentice Hall of India Publishing Sth Edition 2006.
- W.D. Callister, "Materials Science and Engineering", 8th Edition, 2006.

Reference Books:

- W. F. Smith - Foundation of Materials Science and Engineering, McGraw-Hill International, 5"Edition, 2009, New York.
- K. Schroder, Electronic Magnetic and Thermal properties of Solids, Marcel Dekker, 1" Edition,1978, New York.

ESC: Structure and Properties of Materials (Laboratory)
Course Outcomes: students will be able to:
At the end of the laboratory work, students will demonstrate the ability to: 1. Perform tensile and compression test on universal testing machine and analyze the results obtained. 2. Select and perform appropriate hardness test for a given material. 3. Identify the situation under which impact testing would be needed and able to perform the test. 4. Perform torsion and bend tests. 5. Select the appropriate non-destructive test and perform it.
List of Experiments/Assignments: (Any 08)
1. Study of universal testing machine: Principle and Construction. 2. Tensile Test: to conduct tensile test on standard of M.S./C.I. Plotting of stress- Strain curves and comparison of test results. 3. Study the effect of gauge length on percent elongation. 4. Study of Hardness Testing Machines such as I) Brinell II) Vickers III) Poldi. 5. Study of Rockwell /Rockwell superficial hardness testing machines and testing various materials with these machines using different loads and indenters (i.e. scales). 6. Study of microhardness and Shores Scleroscope techniques. 7. Compression Test on C.I. /Aluminium or Brass. 8. Study of the effect of L/D ratio on the compression test results. 9. Study of pendulum impact testing machine and conducting impact test on samples of various materials /with different notches and interpretation of results. 10. Torsion test on wire samples of mild steel/spring steel. 11. Bend test on steel plate and bar samples. 12. Study of dye penetrant, magnetic particles, eddy current, radiography, ultrasonic methods.

DESIGN THINKING IDEA LAB (DTIL)						
Course Code	MFG-25001		**Examination Scheme**			
Teaching Scheme	2-0-2-1		**MSE**	30	**CIE**	100
Credits	3		**CIE**	20		
			ESE	50		

Course Outcomes: Student will able to

1. Compare and classify the various learning styles and Outline the psychological principles in Design Thinking methodology,
2. Infer the Design Thinking framework and Experiment with the process till ideation using human centric tools,
3. Propose real-time innovative engineering product designs and Choose appropriate frameworks, strategies, techniques during prototype development,
4. Appraise user feedback and Propose corrective innovative solutions to create better customer experience.

Unit 01:	**[2 Hrs]**
An Insight to Learning Experiential Learning Styles, Self-assessment	
Unit 02:	**[2 Hrs]**
Psychological Principles in Design Thinking Perception & Observation, Imagination & Creative Confidence (lateral thinking & 6 thinking hats)	
Unit 03:	**[2 Hrs]**
Design Thinking Framework Introduction to different frameworks of DT, Stanford d. school framework Empathize, Define, Ideate, Prototype, Test	
Unit 04:	**[2 Hrs]**
User-Design Relationship Levels of Designs Understanding users through interviews, personas, empathy maps and need identification	
Unit 05:	**[2 Hrs]**
Introduction to Human Centric Tools in Design Thinking Process Brainstorming & Mind mapping Affinity diagrams POV and HMW Role play & Visual storytelling	
Part 2- Design (IDEA Lab)	
Unit 01:	**[2 Hrs]**
Process of Product Design Conventional design process vs. Co-design process (Case study) Problem identification and definition (everyday problems) Ideation and alternatives-SCAMPER	
Unit 02:	**[2 Hrs]**

Prototyping Prototype development for the solution offered	
Unit 03:	**[2 Hrs]**
Testing Test group marketing	
Unit 04:	**[2 Hrs]**
Design Thinking & Customer Centricity Customer Challenges, Enhancing Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design	
Unit 05:	**[2 Hrs]**
Feedback, Re-Design & Re-Create Feedback loop, Focus on User Experience, Address "Ergonomic challenges", User focused design	

Suggested Learning Resources:
Reference

1. Norman, D. (2013). The Design of Everyday Things. Basic Books, NY.
2. Norman, D. (2004). Emotional Design. Basic Books, NY.
3. Brown, T. (2019). Change by Design. HarperCollins Publishers, NY.
4. Lal, D. M. (2021). Design Thinking- Beyond the Sticky Notes. Sage Publications India Pvt. Ltd.
5. Malik, A. D. M. (2019). Design Thinking for Educators. Notion Press, Chennai, India.
6. E. F. Crawley, "Creating the CDIO Syllabus, a universal template for engineering education," *32nd Annual Frontiers in Education*, Boston, MA, USA, 2002, pp. F3F-F3F, doi: 10.1109/FIE.2002.1158202.
7. Dym, C. L., Agogino, A. M., Eris, O., Frey, D. D., & Leifer, L. J. (2005). Engineering design thinking, teaching, and learning. *Journal of engineering education*, *94*(1), 103-120.
8. Panke, S. (2019). Design thinking in education: Perspectives, opportunities and challenges. *Open Education Studies*, *1*(1), 281-306.
9. Parmar, A. J. (2014, October). Bridging gaps in engineering education: Design thinking a critical factor for project based learning. In *2014 IEEE frontiers in education conference (FIE) proceedings* (pp. 1-8). IEEE.

Thompson, L., & Schonthal, D. (2020). The Social Psychology of Design Thinking. California Management Review, 62(2), 84–99. https://doi.org/10.1177/0008125619897636

PCC-01: Discrete Structures

Offered to CSE and AIML students

Course Code:		**Examination Scheme**			
Teaching Scheme	3-1-0-1	MSE:	30	CIE	100
Credit:	4	CIE	20		
		ESE:	50		

Course Outcomes: Students will be able to:

1. Explain formal logic and different proof techniques.
2. Recognize relation between different entities using sets, functions, and relations.
3. Solve problems related to counting.
4. Relate, interpret, and apply the concepts to various areas of computer science.

Unit 1: Set Theory, Logic and Proofs **[5 Hrs]**

Propositions, Conditional Propositions, Logical Connectivity, Propositional calculus, predicates and Quantifiers, First order logic, Proofs: Proof Techniques, Mathematical Induction, Set, Combination of sets, Finite and Infinite sets, countable and Uncountable sets, Principle of inclusion and exclusion.

Unit 2: Relations, Recurrence Relations Sequence & Sums **[5 Hrs]**

Definitions, Properties of Binary Relations, Equivalence Relations and partitions, Partial ordering relations and lattices, Chains and Anti chains. Theorem on chain, Warshall's Algorithm & transitive closure.

Unit 3: Counting **[5 Hrs]**

Basic Counting Techniques (sum, product, subtraction, division, exponent), Pigeonhole and Generalized Pigeonhole Principle with many examples, Permutations and Combinations and numerical problems, Binomial Coefficients Pascal's, Identity and Triangle

Unit 4: Functions, Recurrence Relations & Advanced Counting Techniques **[5 Hrs]**

Functions, Types of Functions, Functions: Definition, Domain, Range, Image, etc. Types of functions: Surjection, Injection, Bijection, Inverse, Identity, Composition of Functions, Generating Functions. Boolean Functions, Representing Boolean Functions, Recurrence Relations, solving linear Recurrence relations, Divide and conquer algorithms and recurrence relations, generations functions inclusion-exclusion, Applications.

Unit 5: Algebraic Systems: **[4 Hrs]**

Algebraic Systems, Groups, Semi Groups, Monoids, Subgroups, Permutation Groups, Codes and Group codes, Isomorphism and Automorphisms, Homomorphism and Normal Subgroups, Ring, Field

Unit 6: Graphs (Self-study) **[6 Hrs]**

Graphs & Graph Models, Graph Terminology and Special types of graphs, Representation of graphs and isomorphism, Multigraphs & Weighed Graphs, Paths and Circuits, Shortest path in weighed graphs, Travelling Salesman problem

Textbooks:

[1] "Discrete Mathematics and Its Applications", Kenneth H. Rosen, 7th Edition, Tata McGraw-Hill, 2017, ISBN: 9780073383095.

[2] "Elements of Discrete Mathematics", C. L. LIU, 4th Edition, Tata McGraw-Hill, 2017, ISBN-10: 1259006395 ISBN-13: 978125 9006395

Reference Books:

[1]	"Discrete Mathematical Structures", G. Shanker Rao, 2nd Edition2009, New Age International, ISBN-10: 8122426697, ISBN-13: 9788122426694 2.
[2]	"Discrete Mathematics", Lipschutz, Lipson, 2nd Edition, 1999, Tata McGraw-Hill, ISBN: 007 463710X
[3]	K. Balakrishnan, 1st Edition, 2004, Tata McGraw-Hill, ISBN-10: 0- 07-058718-3, ISBN-13: 3. "Graph Theory", V. 9780070587182.
[4]	"Discrete Mathematical Structures", B. Kolman, R. Busby and S. Ross, 4th Edition, Pearson Education, 2002, ISBN: 8178085569
[5]	"Discrete Mathematical Structures with application to Computer Science", J. Tremblay, R. Manohar, Tata McGraw-Hill, 2002, ISBN: 0070651426
Suggested List of Assignments/Problems in the Tutorial:	
[1]	Case study/Tutorial on mathematical proofs i.e. Fibonacci series, geometric series, chessboard trio-minos problem etc. (as per instructor).
[2]	Case study/Tutorial on proposition calculus.
[3]	Case study/Tutorial on predicates and quantifiers.
[4]	Case study/Tutorial on Graphs (Travelling salesman problem)
[5]	Case Study/Tutorial on Divide and Conquer applications.

(PCC 01) Electrical and Electronic Measurements and Instrumentation						
Course Code			Examination Scheme			
Teaching Scheme	3-0-2-1		MSE	30	CIE	100
Credits	4		CIE	20		
			ESE	50		

Course Outcome: students will be able to:

At the end of the course, students will demonstrate the ability to

1. Identify various basic movement systems, gain proficiency in the use of shunts and multipliers and calibration of energy meters and wattmeters.
2. Solve the problems for measurement of resistance, inductance and capacitance using various DC and AC bridges.
3. Analyze the functioning and use of electronic meters in electronic networks.
4. Identify and select different electronic and electrical transducers for measurement of various electrical and non-electrical quantities.

Unit 1	**(5 Hrs)**

Electrical Measurement and Measuring Instrument: Definition of measurement, unit, dimensions, classification of instruments, PMMC, moving iron, dynamometer and induction type instruments, ammeter, voltmeter, wattmeter and energy meter, measurement of power in balanced and unbalanced electrical systems. Instrument transformers – current transformers, potential transformers, ratio and phase angle errors, design considerations and testing. Special measuring instruments – dynamometer type single and three-phase power factor meter, digital frequency meters, synchroscopes, tri-vector meter, maximum demand meter, flux meter.

Unit 2	**(5 Hrs)**

Measurement of Resistance, Inductance and Capacitance: Measurement of low, medium and high resistance, insulation resistance, earth resistance, wheatstone bridge, Kelvin double bridge, Megger, AC bridges for measurement of inductance and capacitance.

Unit 3	**(5 Hrs)**

Electronic Measurements: Average, peak and true rms response instruments, Hall effect instruments, digital voltmeter, multimeter, wattmeter and energy meter. Cathode ray ocelot scope: time frequency and phase angle measurement using CRO, digital storage oscilloscope, harmonic and distortion analyzer, spectrum and wave analyzer, power analyzer.

Unit 4	**(5 Hrs)**

Sensors & Measurements of Non-Electrical Quantities: Force measurement using strain gauges, displacement measurements using LVDT, temperature measurement using RTD, thermistor, thermocouple, bellows, and diaghragm. Flow measurement using rotameter, electromagnetic flowmeter. Speed measurement using magnetic pick up and photoelectric pick up.

Unit 5	**(4 Hrs)**

Introduction To Instrumentation: Definition of instrumentation, purpose of instrumentation. Transducers: definition, classification, selection of transducers, resistive transducers.

Textbooks:

- A. K. Sawhney, "Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai and Co. 2015.

- Helfrick, Albert D., and William David Cooper, "Modern electronic instrumentation and measurement techniques". Englewood Cliffs, NJ: Prentice Hall, 1990.
- Martin U. Reissland, "Electrical measurements: fundamentals, concepts, applications". Bohem press, 1989.
- Oliver & Cage, "Electronic Measurements & Instrumentation", McGraw Hill, 1979.

Reference books:

- M. A. Baldwin, "Fundamentals of electrical measurements." Publication – Lyall Book depot, Ludhiyana.
- V. Popov, "Electrical measurements", Mir Publishers. Moscow.
- Johes B. E., "Instrumentation Measurement and Feedback" publication Tata McGraw Hill, New Delhi edition 1978
- Enotes: https://nptel.ac.in/courses/108105153

Electrical and Electronic Measurements and Instrumentation Laboratory	

Laboratory Outcomes:

At the end of the laboratory work, students will demonstrate the ability to:

1. Explain and physically identify the parts like moving coil, control system, damping systems, pointer, shunts, multipliers etc. of different types of deflection systems.
2. Handle cathode ray ocelot scope independently and use it effectively for measurement of various patterns and waveforms.
3. Measure power in three-phase circuits using analogue wattmeter and by using digital power analyzer.
4. Demonstrate working of various biomedical instruments.
5. Recognize various transducers and use them in the measurement of various electrical and non-electrical quantities.

List of experiments:

1. Study of moving iron, PMMC and dynamometer type instruments (basic moving systems).
2. Measurement of power in three-phase balanced and unbalanced circuits by conventional two wattmeter method and by power analyzer.
3. Measurement of voltage, current, power using digital oscilloscope and power analyzer.
4. Comparative study of temperature measurement using RTD and thermocouple.
5. Study of strain gauge and measurement of force using it.
6. Measurement of light intensity using Lux- meter and to realize the light intensity distribution with change in distance.
7. Study of construction of LVDT and measurement of displacement, force and pressure by using it.
8. Calibration of single-phase energy meter (Analogue and Digital) for energy measurement.
9. Measurement of R, L and C using different bridges and confirmation with analytical calculations.
10. Speed measurement using photoelectric pick up, magnetic pick up and stroboscope.

Demonstration of biomedical instruments: Electrocardiogram (ECG), Sphygmomanometer (BP-measurement).

Foundations of Electronics and Emerging Technologies					
Course Code		**Examination Scheme**			
Teaching Scheme	**3-0-2-1**	**MSE**	30	**CIE**	100
Credits	**4**	**CIE**	20		
		ESE	50		

Course Outcomes: students will be able to:

1. Explain the fundamentals of electronic systems, op-amps, and network functions. (BL2)
2. Analyze circuits using network functions and frequency response concepts. (BL4)
3. Design analog filters for signal conditioning in real-world systems. (BL3)
4. Integrate sensors with conditioning circuits for practical applications. (BL3)
5. Apply control system principles using feedback and stability analysis. (BL3)
6. Discuss emerging technologies and their societal relevance. (BL2)

Unit 1 : Introduction to Electronic Systems and Op-Amp Fundamentals:	**[4 Hrs]**
Scope of Electronics and Communication Engineering. Structure of an electronic system - input, processing, feedback, output. Review of passive and active components. Operational amplifiers - characteristics, inverting/non-inverting amplifiers, comparator circuits. Interfacing and importance of signal conditioning.	
Unit 2 : Network Functions and Circuit Realization:	**[4 Hrs]**
Mathematical modeling of circuits - impedance, admittance, transfer functions. Overview of frequency response, poles, and zeros. Foster and Cauer realizations (introductory level). Practical implications in filters, amplifiers, and control circuits.	
Unit 3 : Analog Filter Design and Applications:	**[4 Hrs]**
Types of filters - low-pass, high-pass, band-pass, band-stop. Butterworth and Chebyshev filter characteristics. Active filter design using op-amps.	
Unit 4 : Sensors, Signal Conditioning and Interface Systems:	**[4 Hrs]**
Overview of sensors and transducers (temperature, light, pressure, biomedical). Interfacing with op-amp circuits for amplification, filtering, and noise reduction. Calibration and error analysis. Case examples: environmental monitoring, wearable devices.	
Unit 5 : Fundamentals of Control Systems:	**[4 Hrs]**
Open-loop and closed-loop systems. Block diagram representation and transfer functions. Concepts of feedback, stability, and steady-state error. Applications: robotics, motor control, biomedical instrumentation.	
Unit 6: Emerging Technologies in Electronics and Communication:	**[4 Hrs]**

5G/6G Communication - architecture, spectrum, IoT and AR/VR use cases. VLSI & Nanoelectronics: chip design, scaling, SoC, low-power devices. Medical Electronics - biosensors, imaging, telemedicine innovations.

IoT & Smart Systems - connectivity, data processing, automation. Green Electronics and AI/ML: sustainable designs, predictive analytics. Industry trends and case studies demonstrating integration of electronics, control, and communication.

Textbooks:

1.Sedra, A.S. & Smith, K.C., "Microelectronic Circuits", 8th Edition, Oxford University Press, 2020.

2. Van Valkenburg, M.E., "Network Analysis", 3rd Edition, Pearson Education, 2015 (reprint of classic text)

3. Ogata, Katsuhiko, "Modern Control Engineering", 5th Edition, Prentice Hall, 2010.

Reference Books:

- Rappaport, T.S., "Wireless Communications: Principles and Practice", 2nd Edition, Pearson, 2010.
- Douglas V. Hall, "Microelectronics and VLSI Design", 2nd Edition, McGraw-Hill, 2011.
- Webster, J.G. "Medical Instrumentation: Application and Design", 4th Edition, Wiley, 2009.
- Raj Kamal, "Internet of Things: Architecture and Applications", 2nd Edition, McGraw-Hill, 2021.
- Stuart Russell & Peter Norvig, 'Artificial Intelligence: A Modern Approach", 4th Edition, Pearson, 2020.

Recent IEEE Spectrum / IEEE Communications Magazine / IEEE Internet of Things Journal

Foundations of Electronics and Emerging Technologies (Lab)
Course Outcomes: students will be able to:
1. Operate electronic instruments and simulation tools to study basic circuits. (BL3) 2. Implement op-amp and filter circuits for signal processing. (BL3) 3. Characterize sensors and demonstrate their use in signal conditioning. (BL3) 4. Differentiate between open-loop and closed-loop control using experiments. (BL2) 5. Demonstrate awareness of communication and IoT applications through simulations. (BL2)
Experiments:
1. Study of op-amp amplifier & comparator circuits with sensor interface. 2. Verification of frequency response of RC/RL circuits. 3. Design and testing of low-pass and high-pass active filters. 4. Implementation of band-pass filter and observation of frequency selection. 5. Simulation of Foster and Cauer realizations. 6. Study of LDR and thermistor with signal conditioning circuits. 7. Biomedical sensor interfacing (pulse/ECG module with filter circuit). 8. Study of noise effect and error reduction in sensor output. 9. Open-loop vs closed-loop control circuit implementation. 10. Simple temperature-controlled system using sensor + feedback. 11. Demonstration of modulation schemes (AM/FM using software). 12. Awareness demo: IoT-based sensor node or 5G communication simulation.

Basics of Measurement and Sensors					
Course Code		**Examination Scheme**			
Teaching Scheme	3-0-2-1	**MSE**	30	**CIE**	100
Credits	4	**CIE**	20		
		ESE	50		

Course Outcomes: students will be able to:

2. List different types of sensor/measuring instruments used for displacement, velocity, acceleration, force and torque.
3. To introduce measuring instrument and implement resistance, capacitance and inductance measurement system.
3. Define and describe working principles and characteristics of the sensors and Measuring Instruments.
4. Select and defend suitable sensor/measuring system for a specific application

Unit 1 Introduction of measuring Systems:	**(4 Hrs)**

Concepts and terminology of measurement system, transducer, sensor, range and span, classification of transducers, static and dynamic characteristics, selection criteria, sources of errors and their statistical analysis, standards and calibration.

Unit 2 Resistance, Inductance & Capacitance Measurement:	**(4 Hrs)**

Wheatstone bridge, Kelvin Bridge, Maxwell's bridge, Hay's bridge, Schering bridge: design and applications.

Unit 3 Measuring Instruments:	**(4 Hrs)**

Oscilloscope: Introduction, various parts, front panel controls, use of CRO for measurement of voltage, current, period, frequency. Phase angle & frequency by Lissajous pattern. Introduction to DSO, DMM.

Unit 4 Displacement Measurement	**(4 Hrs)**

Linear and rotary type Potentiometer, Strain gauge, LVDT, RVDT, Eddy current type Transducers, Capacitive, Optical transducers, Hall effect transducers.

Unit 5 Velocity and Acceleration Measurement:	**(4 Hrs)**

Moving magnet and moving coil, tachometers and its types. Accelerometer: Potentiometric, LVDT, Piezo-electric type

Unit 6 Force and torque measurement:	**(4 Hrs)**

Basic methods of force measurement, elastic force traducers, strain gauge, load cells, piezoelectric force transducers, Strain gauge torque meter, Inductive torque meter, Magneto- strictive transducers, torsion bar dynamometer.

Textbooks:

1.	A. K. Sawhney, “Electrical and Electronic Measurements and Instrumentation”, DhanpatRai and Sons, 12th ed., 2005
2.	B. C. Nakra and K. K. Choudhari, “Instrumentation Measurements and Analysis” by, Tata McGraw Hill Education, 4th ed., 2016
Reference Books:	
1.	E.O. Doebelin, “Measurement Systems”, McGraw Hill, 6th ed., 2017
2.	D. Patranabis, “Principle of Industrial Instrumentation”, Tata McGraw Hill, 2nd ed., 1999
3.	A. J. Bouwens, “Digital Instrumentation”, McGraw-Hill, 6th reprint, 2008
4.	H S Kalsi, “Electronic Instrumentation”, Tata McGraw-Hill, 4th ed., 2017
5.	Albert D. Helfrick, William David Cooper, “Modern electronic Instrumentation and Measurement Techniques” Prentice Hall, Second ed., 1990
List of Experiments:	
1.	Resistance measurement using Wheatstone bridge
2.	Design and implementation of resistance measurement using Kelvin double bridge
3.	Design, implementation of inductance measurement using Hay’s bridge
4.	Characterization and calibration of potentiometer as displacement sensor. Study of loading effect on potentiometer (linear and rotary).
5.	Characterization and calibration of LVDT based displacement measurement system.
6.	Characterization of strain gauge using cantilever beam.
7.	Characterization and calibration of piezoelectric measurement system.
8.	Measurement using proximity sensors (inductive/Capacitive) for an application

Engineering Mechanics					
Course Code		**Examination Scheme**			
Teaching Scheme	3-0-2-1	**MSE**	30	**CIE**	100
Credits	4	**CIE**	20		
		ESE	50		

Course Outcomes: Students will be able to:

1.	Apply principles of statics to determine resultants and equilibrium conditions for 2D and 3D force systems.
2.	Analyze and compute forces in statically determinate beams, trusses, and cable systems using equilibrium equations.
3.	Evaluate and illustrate internal shear force and bending moment distributions in beams.
4.	Apply laws of dry friction to solve practical engineering problems involving wedges, screws, and belt drives.
5.	Solve problems of kinematics of particles in rectilinear and curvilinear motion using appropriate coordinate systems.
6.	Apply Newton's second law, Work–Energy, and Impulse–Momentum principles to dynamic systems including central impact.

Unit 1:	**Concurrent Force system**	**(4 Hrs)**

Forces, Free-Body Diagrams, Resultant and Equilibrium of Two-dimensional and Three- dimensional concurrent force System (2D and 3D)

Unit 2:	General Force system	**(4 Hrs)**

Moment vector, Couples, Equivalent Force systems, Resultant and Equilibrium of Two- dimensional (2D) general force System.

Unit 3:	Structures in Equilibrium	**(4 Hrs)**

Beams, Trusses, Cables, Dry Friction for inclined planes, Belt friction

Unit 4:	**Internal Forces in Determinate Beams**	**(4 Hrs)**

Shear and Bending Moment in a Beam, Shear and Bending-Moment Diagrams, Relations among Load, Shear, and Bending Moment.

Unit 5:	**Motion of a Point**	**(4 Hrs)**

Position, Velocity and Acceleration, Straight Line motion, Curvilinear Motion, Cartesian coordinates, normal & tangential coordinates and, polar coordinates. Relative motion

Unit 6:	**Motion of a Point**	**(4 Hrs)**

Newton's second law, Work-Energy Principle, Impulse-Momentum Principle, Direct central impact

Textbooks:

1.	Hibbeler R. C., "Engineering Mechanics - Statics", 14th Edition Prentice Hall
2.	Hibbeler R. C., "Engineering Mechanics - Dynamics" , 14th Edition, Prentice Hall
3.	Beer F. P., Johnston E. R. et al., "Vector Mechanics For Engineers:]Statics Dynamics",12th Edition, McGraw-Hill Publicatio

Reference Books:

1.	Meriam J. L., Kraige L. G.,"Engineering Mechanics - Statics ", John Wiley and Sons, 8th Edition

2.	Meriam J. L., Kraige L. G., "Engineering Mechanics - Dynamics", John Wiley andSons, 8th Edition
3.	Bedford and W. Fowler, "Engineering Mechanics - Statics and Dynamics", Pearson Publications
Web Resources:	
1.	Engineering Mechanics – Prof. Manoj K. Harbola, IIT Kanpur NPTEL course covering statics & dynamics fundamentals. Link: https://nptel.ac.in/courses/115104094 NPTEL
2.	Engineering Mechanics – Prof. K. Ramesh, IIT Madras SWAYAM pre-degree course covering free-body diagrams, truss/beam analysis, friction, kinematics. Link: https://onlinecourses.nptel.ac.in/noc21_me70/preview NPTEL Online Courses
3.	Engineering Mechanics (latest batch) – similar SWAYAM content with updated structure. Link: https://onlinecourses.nptel.ac.in/noc23_me74/preview
	List of Assignments in the Laboratory:
1.	Assignment 1: Resultant of concurrent and non-concurrent coplanar force systems; free body diagram practice.
2.	Assignment 2: Analysis of a planar truss using Method of Joints and Method of Sections.
3.	Assignment 3: Drawing shear force and bending moment diagrams for statically determinate beams under point, UDL, and moment loads.
4.	Assignment 4: Problems on rectilinear and curvilinear motion (Cartesian, polar, and NT coordinates).
5.	Assignment 5: Application of Newton's second law and D'Alembert's principle to connected body systems (pulley, blocks).
6.	Assignment 6: Work–energy and impulse–momentum problems including collisions and impact.

Computer Aided Engineering Drawing					
Course Code		**Examination Scheme**			
Teaching Scheme	3-0-2-1	**MSE**	30	**CIE**	100
Credits	4	**CIE**	20		
		ESE	50		

Course Outcomes: Students will be able to:

1. Familiarize with different drawing tools, technical standards and procedures for construction of different geometries and engineering objects.
2. Develop the ability to visualize and communicate three dimensional shapes and their sections by representing three-dimensional objects into two-dimensional views using concept of orthographic projection.
3. Apply the visualization practices to draw isometric projection from a given orthographic view.
4. Draw the development of lateral surfaces of assembly and cut sections of different geometrical solids for engineering applications.
5. Draw 2D and 3D drawings using computer aided drafting tool.

Unit 1:Introduction to Engineering Drawing: **[4 hours]**

Drawing tools, drawing standards, line conventions, lettering, systems and rules of dimensioning

Unit 2:Orthographic Projections: **[4 hours]**

Principles of Orthographic Projections, types of orthographic projections–First angle and third angle projections, obtaining orthographic projections of given solids and machine elements by using first angle projection method along with sectional views.

Unit 3: Isometric Projections: **[4 hours]**

Principles of Isometric projection – Isometric and natural Scale, Isometric views of simple and compound solids, drawing isometric views from given orthographic views.

Unit 4: Development and Antidevelopment of lateral surfaces of solids **[4 hours]**

Industrial applications of development of lateral surface, methods of development, development and antidevelopment of lateral surfaces for cut section of Prism, Pyramid, and Cone

Unit 5: 2D and 3D views using CAD software **[4 hours]**

Basic drawing commands and its applications to draw 2D views using CAD software. Basic drawing commands and its applications to draw 3D views using CAD software

Unit 6: Introduction to Machine Drawing **[4 hours]**

Machine elements and their conventional representation such as keys, couplings springs, gears, bolted, riveted, welded and adhesive joints, piping layouts, pipe fittings.

Textbooks:

1. N.D.Bhatt, “Elementary Engineering Drawing”, Charotar Publishing House, Anand (India)
2. M.L.Dabhade, “Engineering Graphics” I, Vision Publications, Pune
3. Dhananjay Jolhe , “Engineering Drawing”, Tata McGraw Hill publishing company Ltd., New Delhi

Reference Books:

1. Warren Luzzader, “Fundamentals of Engineering Drawing”, Prentice Hall of India, New Delhi.
2. Shah, M.B. & Rana B.C. , “Engineering Drawing and Computer Graphics”, Pearson

Education

Agrawal B. & Agrawal C. M. , “Engineering Graphics”, Tata McGraw Publication
Suraj Singh , “ Civil Engineering Building Practice ”

Course Title: Computer Aided Engineering Drawing Laboratory

Course Outcomes: At the end of the course, students will demonstrate the ability to

1. Familiarize with different drawing tools, technical standards and procedures for construction of different geometries and engineering objects.
2. Develop the ability to visualize and communicate three dimensional shapes and their sections by representing three-dimensional objects into two-dimensional views using concept of orthographic projection.
3. Apply the visualization practices to draw isometric projection from a given orthographic view.
4. Draw the development of lateral surfaces of assembly and cut sections of different geometrical solids for engineering applications.
5. Draw 2D and 3D drawings using computer aided drafting tool

List of Assignment:

Draw 02 examples on each assignment on A2 size drawing sheet

Assignment 1:

Draw orthographic views of any machine elements along with sectional view.

Assignment 2:

Draw isometric view for given orthographic views.

Assignment 3:

Draw the development and antidevelopment of lateral surfaces of solids.

Draw 04 examples on each assignment using CAD software

Assignment 4:

Draw orthographic views of any machine elements along with sectional view.

Assignment 5:

Draw isometric view for given orthographic views. (3D drawings / Modeling)

PCC: Fuels, Furnaces and Refractories (Theory)					
Course Code		**Examination Scheme**			
Teaching Scheme	3-0-2-1	**MSE**	30	**CIE**	100
Credits	4	**CIE**	20		
		ESE	50		

Course Outcome: students will be able to:

1. Recall and explain the types, properties, and analysis of fuels and their applications in industries.
2. Describe coal carbonization processes and apply knowledge of coke and producer gases in metallurgical contexts.
3. Classify and analyze the construction and operation of various industrial and heat treatment furnaces.
4. Calculate combustion parameters and evaluate furnace efficiency, environmental controls, and waste heat recovery. solve numerical problems related to electric arc, induction, and resistance furnaces for industrial use.
5. Identify, analyze, and select suitable refractories based on their properties, manufacturing, and failure modes.

Unit:1 Fuel: **[3hours]**

Definition, Comparative study of solid, liquid, and gaseous fuels. Primary and Secondary fuels. Constitution, classification and grading of coal. Characterization of Coal: Proximate analysis, Ultimate analysis, Calorific value. Coal washing. Coal blending and its importance in metallurgical industries. Principles of fuel combustion. Conventional and newer sources of energy.

Unit: 2 Carbonization of coal: **[3hours]**

Caking, Coking and Non- coking Coals. Metallurgical coke preparation, Testing and properties of coke. Formed coke, Dry quenching of coke. Manufacture, properties and uses of Producer gas and Water gas. Properties and uses of Blast furnace gas and Coke oven gas.

Unit: 3 Furnaces: **[3hours]**

Classification of furnaces, construction, working & application of
various fuel fired heating furnaces, materials for industrial furnace construction,
accessories such as burners, blowers, pumps, exhaust systems. Heat treatment furnaces such as salt bath, pit- type, fluidized bed furnaces, sintering furnaces etc

Unit: 4 Combustion calculations: **[3hours]**

Efficient combustion of fuels, excess air requirement, operation, and control of industrial furnaces. Furnace atmospheres, gas flow and heat transfer in furnaces, Wall Losses, Radiation Heat Loss from Surface of Furnace Thermal efficiency. Environmental controls and safety measures. Waste heat recovery

Unit: 5. Electric Arc and Electric Resistance furnaces: **[3hours]**

Direct and indirect arc furnaces, constructions, working and applications, numerical. Induction furnace: principle, core and coreless types, skin effect, calculation of minimum frequency, power generation, depth of penetration, numerical. Electric resistance heating, direct and indirect resistance heating, melting of glasses and electric salt bath furnace, calculations of power requirement.

Unit: 6. Refractories: **[3hours]**

Desirable properties of refractories. Methods of classification. Manufacturing methods of common refractories and properties of Fireclay, Silica, Magnesite, and Chrome- Refractories. Metallic Refractories. Testing of Refractories. Modes of failure of refractories in service and their prevention. Selection of appropriate refractories for metallurgical applications
TEXTBOOKS/ REFERENCE BOOKS:
1. Fuels, furnaces and refractories, R. C. Gupta, 1st Edition, PHI Learning Pvt. Ltd. Delhi, 2016. 2. Fuels, furnaces, refractories and pyrometry, A.V.K. Suryanarayana, 2nd edition, B.S. Publication. 2015. 3. Elements of fuels, furnaces & refractories O.P. Gupta, 6th Edition, Khanna Publishers, 2014. 4. Elements of Refractory Technology, O.P. Gupta, 1st edition, Khanna Book Publishing Co. Ltd., 2017. 5. Industrial Furnaces, W. Trinks, M.H. Mawhinney, R.A. Shannon, R.J. Reed, and J.R. Garvey, 6th edition, John Wiley and Sons, 2003. 6. Fuels, furnaces and refractories, J. D. Gilchrist, Pergamon Press, 1977.

PCC: Fuels, Furnaces and Refractories (Laboratory)
Course Outcomes: students will be able to:
1. Analyze the estimation of various properties of fuels and oils. 2. Understand the working principles thermocouples and their calibration. 3. Compare different heating elements used in industrial furnaces. **4.** Understand the me thod of making and testing the refractory products.
List of Experiments/Assignments: (Any 08)
1. To determine the viscosity of the given fuel oil by using the Redwood and Engler's viscometer. 2. To determine the flash point and fire point of the given fuel oil using the Abel, Pensky-Martan, and Cleveland's apparatus. 3. To determine the proximate analysis of the given coal sample. 4. To determine the Sulphur content of the given coal sample. 5. To determine the calorific value of the given fuel using the bomb's calorimeter. 6. To study about different thermocouples and their calibration. 7. To study about various heating elements including measure of resistance. 8. To study the variation of resistance with respect to temperature in Kanthal / Nichrome wire 9. To study about various parts of furnaces (Muffle, Induction, and Raising Hearth furnace) 10. To determine the packing density of refractory raw materials. 11. To study of effect of composition, forming pressure & firing temperature on some properties of refractory bodies. 12. To determine the spalling resistance (Thermal Resistance Shock Test) of refractory bodies. 13. Design and construction muffle furnace. 14. Study of various types of Pyrometers 15. Estimation of minimum amount of air required for a fuel of known composition, theoretical and actual combustion processes (Air fuel ratio) 16. Study of methods of waste heat utilization- regeneration, recuperators, waste heat boilers.

Essentials of Production Systems and Smart Factories					
Course Code		**Scheme of Evaluation**			
Teaching Scheme	3-0-2-1	**CIE**	20	**CIE**	100
Credits	4	**MSE**	30		
		ESE	50		

Course Outcomes: Students should be able to

1. Describe the types, functions, and performance metrics of manufacturing and production systems.
2. Explain the principles of automation, levels of automation, and role of manual labor in production systems.
3. Illustrate the working of sensors, actuators, and industrial control systems used in modern factories.
4. Classify and compare various material handling and storage systems including automated solutions.
5. Analyze different types of manufacturing systems including flexible and automated systems.
6. Interpret the role of digital technologies like MES, ERP, and Industry 4.0 in manufacturing environments.

Course Objectives:

1. To introduce the fundamentals of manufacturing systems.
2. To familiarize students with automation concepts and principles.
3. To explain the essential elements of industrial control systems.
4. To provide an overview of material handling and storage systems.
5. To expose students to diverse manufacturing systems.
6. To introduce digital transformation in manufacturing.

Unit 1:	***Foundations of Manufacturing and Production Systems***	(4 hours)

Manufacturing industries and products, Manufacturing operations and facilities, Product/Production relationships, Production performance metrics, Manufacturing costs, KPIs in manufacturing facilities or factory.

Unit 2:	***Automation in Manufacturing***	(4 hours)

Automation in production systems, Manual labor and automation strategies, Basic elements of an automated system, Advanced automation functions, Levels of automation, Introduction to Industrial Control Systems.

Unit 3:	***Sensors, Actuators, and Control***	(4 hours)

Sensors and actuators, Analog–digital conversions, Input/output devices for discrete data, Continuous vs. discrete control, Process industries vs. discrete manufacturing.

Unit 4:	***Material Handling and Storage***	(4 hours)

Material transport systems, Overview of material handling, Material transport equipment, Conventional storage methods, Automated storage systems.

Unit 5:	***Manufacturing Systems and Cells***	(4 hours)

Overview and components of manufacturing systems, Types of manufacturing systems, Single-station cells (manned/automated), Manual assembly lines and fundamentals, Automated production lines and assembly systems, Flexible manufacturing systems (FMS/FMC), Robotics in manufacturing.

Unit 6:	***Digital Manufacturing & Industry 4.0***	(4 hours)

Manufacturing Execution System (MES), Enterprise Resource Planning (ERP), Checkpoints of MES and ERP, Mapping MES/ERP to KPIs, Role of Industry 4.0 in production, Future factories: trends and technologies

Suggested Textbooks / References

1. **Mikell P. Groover** – Automation, Production Systems, and Computer-Integrated Manufacturing
2. **Kumar, Tiwari et al.** – Smart Manufacturing: Concepts and Methods
3. Industry 4.0: The Industrial Internet of Things – Alasdair Gilchrist
4. Selected papers, online materials from NPTEL/MOOCs

List of Demonstrations/Study/Performing Experiments to be completed as a part of Laboratory component (Any 5):

Exp. No.	Experiment Title	Mapped COs
1	Demonstration of production performance metrics (cycle time, throughput, utilization, efficiency) using simple case data	
2	Study of key performance indicators (KPIs) in a simulated manufacturing facility	CO1
3	Hands-on with basic sensors (proximity, temperature, optical, ultrasonic) and their applications in manufacturing	CO1, CO6
4	Demonstration of actuators (electrical, pneumatic, hydraulic) with simple motion tasks	CO3
5	Experiment on analog-to-digital and digital-to-analog conversion for sensor/actuator interfacing	CO3
6	Simulation of continuous vs. discrete control processes using simple software tools	CO3
7	Study of material handling equipment (conveyors, AGVs, hoists, forklifts) through models or videos	CO3
8	Demonstration of automated storage and retrieval system (AS/RS) using a lab-scale prototype through models or videos	CO4
9	Demonstration of robotics in manufacturing – pick and place robot or robotic arm programming	CO4
10	Study of Industry 4.0 enabling technologies – IoT devices and smart sensors through models/simulation or videos	CO6

Indian Knowledge System (IKS)			
Course Code		**Scheme of Evaluation**	
Teaching Plan	2-0-0-1	**CIE**	20
Credits	2	**ESE**	30
Course Outcomes: Students should be able to			
1] understand ancient Indian knowledge 2] gain knowledge about development of Indian Darshana (Philosophy) 3] locate the roots of sciences in India 4] understand the scientific technological development			
Unit 1: **Introduction to Indian Knowledge System:**			**[4 hrs]**
Indian tradition of knowledge: Para-a-para Vidya- philosophy, Interlinking, Practices of Knowledge Creation- Anvikshiki, Kautuhalshala Scientific attitude			
Unit 2: **Development of Wellness system:**			**[4 hrs]**
Sankhya Philosophy, Ancient Indian Aesthetics, Yoga and Ayurveda, Sankhya			
Unit 3: **Development of Sciences:**			**[3 hrs]**
Astronomy- Aryabhatta, Varahamihira, Geometry Archaeology			
Unit 4: **Development of Technologies:**			**[3 hrs]**
Architecture & Urban Planning, Metallurgy- Copper, Iron, Bronze & alloys, Textiles- Silks, Cotton, weaving, dyeing, printing, Computing @ 13-15 lectures per credit per course			
Suggested learning resources: B. Mahadevan, Bhat Vinayak and Nagendra Pavan R.N., 'Introduction to Indian Knowledge Systems: Concepts and Applications' Dharmapal 'Indian Science and Technology' Kapil Kapoor, Singh Avdhesh Kumar, 'Indian Knowledge Systems' Chattopadhyaya, Debiprasad, History of science and technology in ancient India: the beginnings, Firma KLM Pvt. Ltd. 1986. Irfan Habib (ed.), People's History of India – Vol 20 : Technology in Medieval India, c. 650–1750, Aligarh Historians Society and Tulika Books, 2016. Jan Gonda, A History of Indian Literature, Otto Harrassowitz, Wiesbaden, 1975. L. Gopal and V. C. Shrivastava, History of Agriculture in India (Upto 1200 A. D.), Concept Publishing, New Delhi, 2008. Pushkar Sohoni, Introduction to the History of Architecture in India, IISER, Pune, 2020. Surendranath Dasgupta, A History of Indian Philosophy, Cambridge University press, 1922. Radhavallabh Tripathi, Vāda in theory and practice : studies in debates, dialogues and discussions in Indian intellectual discourses, IIAS, Shimla, 2016. Thanu Padmanabhan (ed.), Astronomy in India : A Historical Perspective, Indian National Science Academy, Springer, New Delhi. 2014.			