

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. 2026-27)


Dean
School of Engineering & Technology
COEP Technological University (COEP Tech)
Shivajinagar, Pune-411005


Dr. Kiran V. Dalvi
Associate Dean
School of Engineering & Technology
COEP Technological University, Pune

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.
1. Student will demonstrate effective communication, lifelong learning ability, integrity, teamwork, 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 relevant to 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: Lifelong 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

Sem - I	Sr. No.	Course Title [#] /Collection ^s	L	T	P	S	Cr	Categorisation
	01	Mathematics ^s -I	2	1	-	1	3	BSC
	02	Applied Sciences ^s -I	2	-	2	1	3	BSC
	03	Applied Sciences ^s -II	1	-	-	1	1	BSC (Optional either in SEM I or II)
	04	Engineering Sciences ^s - I	2	0	2	1	3	ESC
	05	Engineering Sciences ^s - II	3	0	0	1	3	ESC
	06	Engineering Sciences ^s - III	2	0	2	1	3	ESC
	07A*	Engineering Exploration [#]	-	-	6	6	3	VSEC
	07B*	Vocational and Skill Enhancement Courses ^s	1	-	2	2	2	VSEC
	08	Ability Enhancements Courses ^s	-	-	2	2	1	AEC
	09	Co-curricular Activities / Liberal Learning Course ^s	-	-	2	2	1	CCA/LLC
							21/20/19	

***: Half number of students will undergo 07A and remaining 07B**

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F.Y. B. Tech. Engineering

Semester -II

Sem - II	Sr. No.	Course Title [#] /Collection ^{\$}	L	T	P	S	Cr	Categorisation
	01	Mathematics ^{\$} -II	3	1	-	1	4	BSC
	02	Applied Sciences ^{\$} -III	2	-	2	1	3	BSC
	03	Applied Sciences ^{\$} -IV	1	-	-	1	1	BSC (Optional either in SEM I or II)
	04	Engineering Sciences ^{\$} -IV	3	-	0	1	3	ESC
	05	Program Core Course ^{\$}	2	-	2	1	3	PCC
	06	Ability Enhancements Courses ^{\$}	-	-	2	2	1	AEC
	07A*	Engineering Exploration [#]	-	-	6	6	3	VSEC
	07B*	Vocational and Skill Enhancement Courses ^{\$}	1	-	2	2	2	VSEC
	08	Indian Knowledge System (Domain Specific) [#]	2	-	-	1	2	IKS
	09	Co-curricular Activities / Liberal Learning Course ^{\$}	-	-	2	2	1	CCA/LLC
							19/20/21	

***: The student who completed 07A will undergo 07B and vice-versa**



Choice Based Credit System (CBCS) for F.Y. B. Tech. from AY 2026-27 (First Semester)		
Course Category	Course Code	Course Title (Department)
3 Credits (2 Th + 1 T)		
Basic Science Course-Mathematics I (Any One)	26U1BSML002	Matrix Algebra and Calculus
	26U1BSML001	Linear Algebra
3 Credits (2 Th + 1 P)		
Basic Science Course-Applied Sciences I (Any One)	26U1BSPB001	Engineering Physics
	26U1BSPL001	Quantum Physics (2 Th + 1 T)
	26U1BSCB001	Engineering Chemistry
1 Credit (1 Th)		
Basic Science Course-Applied Sciences II (for MECH, ELECT, COMP (DIVISION 1 & DIVISION 2), AIML, INSTRU) (Any One)	26U1BSPL002	Electromagnetism (Physics)
	26U1BSPL003	Semiconductor Physics (Physics)
	26U1BSBL001	Biology for Engineers (Biology)
	26U1BSCL001	Emerging Technologies in Energy Storage (Chemistry)
	26U1BSCL002	Nanomaterials in Emerging Technologies (Chemistry)
ES-I (3 Credits, 2 Th + 1 P)		
Engineering Science Course (Compulsory)	26U1CECB001	Essentials of Civil Engineering (Civil)
	26U1AICB001	Fundamentals of AI (Computer)
	26U1AICB001	Fundamentals of AI (AIML)
	26U1EECB001	Fundamentals of Electrical Engineering (Electrical)
	26U1ETCB001	Elements of Electronics Engineering (E & TC)
	26U1ICCB001	Fundamentals of MATLAB and Simulink (Instrumentation)
	26U1MECB001	Systems in Mechanical Engineering (Mechanical)
	26U1MFEB001	Fundamentals of Production Drawing (Manufacturing)
	26U1MMCB001	Structure and Properties of Materials (Metallurgy)
ES-II (3 Credits, 3 Th)		
Engineering Science Elective Course (Any One from other Disciplines)	26U1ESEL001	Basics of Civil Engineering (Civil)
	26U1ESEL002	AI for Multidisciplinary Applications (Computer)
	26U1ESEL003	Electrical Energy Utilization (Electrical)
	26U1ESEL004	Applied Electronics and IOT (E & TC)
	26U1ESEL005	Fundamentals of Measurement and Sensors (Instrumentation)
	26U1ESEL006	Foundation in Mechanical Engineering (Mechanical)
	26U1ESEL007	Basics of Manufacturing Technology (Manufacturing)
	26U1ESEL008	Nanomaterials (Metallurgy)
ES-III (3 Credits, 2 Th + 1 P)		
Engineering Science Elective Course (Any One from other Disciplines)	26U1ESEB001	Applied Mechanics (Civil)
	26U1ESEB002	Fundamentals of Cyber Security (Computer)
	26U1ESEB003	Basic Electrical Engineering (Electrical)
	26U1ESEB004	Digital Logic Design (E & TC)
	26U1ESEB005	Engineering Graphics (Mechanical)
	26U1ESEB006	Product Prototyping Practices (Manufacturing)
	26U1ESEB007	Fundamentals of Corrosion Engineering (Metallurgy)
3 Credits (3 P)		
Vocational and Skill Enhancement Course (Compulsory)	26U1VSCP001	Engineering Exploration (for MECH, ELECT, COMP (DIVISION 1 & DIVISION 2), AIML, INSTRU)
2 Credits (1 Th + 1 P)		
Vocational and Skill Enhancement Course (for E & TC, MFG, COMP (DIVISION 3 & DIVISION 4), CIVIL, META) (Any One)	26U1VSEB001	Geomatic Engineering (Civil)
	26U1VSEB002	Fundamentals of Construction Practices (Civil)
	26U1VSEB003	Programming for Problem Solving (Computer)
	26U1VSEB004	Web Design (Computer)
	26U1VSEB005	Python Programming (Computer)
	26U1VSEB006	Electrical Maintenance and Safety (Electrical)
	26U1VSEB007	Fundamentals of PLC (Instrumentation)
	26U1VSEB008	Computer Aided Drafting (Mechanical)
	26U1VSEB009	EV Architecture (Mechanical)
	26U1VSEB010	Manufacturing Practices and Fab Lab (Manufacturing)
	26U1VSEB011	Robotics and Drone Operation and Safety (Manufacturing)
1 Credit (1 P)		
Ability Enhancement Courses (Any One)	26U1AECB001	Communication Skills (for MECH, ELECT, COMP (DIVISION 1 & DIVISION 2), AIML, INSTRU)
	26U1AECB002	Personality Development (for E & TC, MFG, COMP (DIVISION 3 & DIVISION 4), CIVIL, META)

1 Credit (1 P)		
Liberal Learning Course (Any One)	26U1LLEP008	Liberal Learning Course - Cultural Club
	26U1LLEP012	Liberal Learning Course - Drama and Film Club
	26U1LLEP029	Liberal Learning Course - Spandan Club
	26U1LLEP001	Liberal Learning Course - Arts and Crafts Club
	26U1LLEP020	Liberal Learning Course - Magazine
	26U1LLEP011	Liberal Learning Course - Debate, Quiz, Model United Nations, and Youth Parliamentary Club
	26U1LLEP015	Liberal Learning Course - Football Club
	26U1LLEP002	Liberal Learning Course - Astronomy Club
	26U1LLEP006	Liberal Learning Course - COEP "Mitra" Club
	26U1LLEP014	Liberal Learning Course - E-Cell
	26U1LLEP010	Liberal Learning Course - Data Science and Artificial Intelligence Club
	26U1LLEP024	Liberal Learning Course - Robot Study Circle Club
	26U1LLEP023	Liberal Learning Course - Ramanujan Maths and Science Club
	26U1LLEP031	Liberal Learning Course - Volleyball Club
	26U1LLEP025	Liberal Learning Course - Rocket Propulsion Centre (RPC) Club
	26U1LLEP026	Liberal Learning Course - Satellite Club
	26U1LLEP003	Liberal Learning Course - Basketball and Badminton Club
	26U1LLEP007	Liberal Learning Course - Cricket Club
	26U1LLEP030	Liberal Learning Course - Spic Macay Club
	26U1LLEP027	Liberal Learning Course - Society of Women Engineering Club
	26U1LLEP005	Liberal Learning Course - Civil Services Aspirant Club
	26U1LLEP022	Liberal Learning Course - Quantum Computing Club
	26U1LLEP018	Liberal Learning Course - Ignited Innovators of India Club
	26U1LLEP004	Liberal Learning Course - Chess and Carrom Club
	26U1LLEP016	Liberal Learning Course - Hockey Club
	26U1LLEP019	Liberal Learning Course - Kabaddi and Kho-Kho Club
	26U1LLEP013	Liberal Learning Course - Drone Club
	26U1LLEP017	Liberal Learning Course - Hyperloop Research and Innovation Club
	26U1LLEP028	Liberal Learning Course - Software Development Club
	26U1LLEP009	Liberal Learning Course - Cyber Security Club
	26U1LLEP021	Liberal Learning Course - National Service Scheme (NSS) Swayamsiddha

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Choice Based Credit System (CBCS) for F.Y. B. Tech. from AY 2026-27 (Second Semester)

Course Category	Course Code	Course Title (Department)
4 Credits (3 Th + 1 T)		
Basic Science Course-Mathematics II (Any One)	26U1BSML004	Vector Calculus and Differential Equations
	26U1BSML003	Probability and Statistics
3 Credits (2 Th + 1 P)		
Basic Science Course- Applied Sciences III (Any One)	26U1BSPB001	Engineering Physics
	26U1BSPL001	Quantum Physics (2 Th + 1 T)
	26U1BSCB001	Engineering Chemistry
1 Credit (1 Th)		
Basic Science Course-Applied Sciences IV (for E & TC, MFG, COMP (DIVISION 3 & DIVISION 4), CIVIL, META) (Any One)	26U1BSPL002	Electromagnetism (Physics)
	26U1BSPL003	Semiconductor Physics (Physics)
	26U1BSBL001	Biology for Engineers (Biology)
	26U1BSCL001	Emerging Technologies in Energy Storage (Chemistry)
	26U1BSCL002	Nanomaterials in Emerging Technologies (Chemistry)
ES-IV (3 Credits, 3 Th)		
Engineering Sciences Elective Course (Any One from other Disciplines)	26U1ESEL001	Basics of Civil Engineering (Civil)
	26U1ESEL009	Fundamentals of Physical Infrastructure (Civil-Planning)
	26U1ESEL002	AI for Multidisciplinary Applications (Computer)
	26U1ESEL003	Electrical Energy Utilization (Electrical)
	26U1ESEL004	Applied Electronics and IOT (E & TC)
	26U1ESEL005	Fundamentals of Measurement and Sensors (Instrumentation)
	26U1ESEL006	Foundation in Mechanical Engineering (Mechanical)
	26U1ESEL007	Basics of Manufacturing Technology (Manufacturing)
	26U1ESEL008	Nanomaterials (Metallurgy)
PCC (3 Credits, 2 Th + 1 P)		
Program Core Course (Compulsory)	26U1CSCB001	Discrete Structure (AIML)
	26U1CECB002	Engineering Mechanics(Civil)
	26U1CSCB001	Discrete Structure (Computer)
	26U1EECB002	Electrical and Electronic Measurement and Instrumentation (Electrical)
	26U1ETCB002	Foundation of Electronics and Emerging Technologies (E&TC)
	26U1ICCB002	Basics of Measurement and Sensor (Instru)
	26U1MECB002	Computer-Aided Engineering Drawing (Mechanical)
	26U1MFCB002	Essential of Production System Smart Factories (Manufacturing)
	26U1MMCB002	Fuel Furnaces and Refractories (Metallurgy)
1 Credit (1 P)		
Ability Enhancement Courses (Any One)	26U1AECB001	Communication Skills (for E & TC, MFG, COMP (DIVISION 3 & DIVISION 4), CIVIL, META)
	26U1AECB002	Personality Development (for MECH, ELECT, COMP (DIVISION 1 & DIVISION 2), AIML, INSTRU)
3 Credits (3 P)		
Vocational and Skill Enhancement Course (Compulsory)	26U1VSCP001	Engineering Exploration (for E & TC, MFG, COMP (DIVISION 3 & DIVISION 4), CIVIL, META)
2 Credits (1 Th + 1 P)		
Vocational and Skill Enhancement Course (for MECH, ELECT, COMP (DIVISION 1 & DIVISION 2), AIML, INSTRU) (Any One)	26U1VSEB001	Geomatic Engineering (Civil)
	26U1VSEB002	Fundamentals of Construction Practices (Civil)
	26U1VSEB003	Programming for Problem Solving (Computer)
	26U1VSEB004	Web Design (Computer)
	26U1VSEB005	Python Programming (Computer)
	26U1VSEB012	Electrical Workshop (Electrical)
	26U1VSEB013	Digital Public Infrastructure (E & TC)
	26U1VSEB014	Data Preprocessing and Visualization (E & TC)
	26U1VSEB008	Computer Aided Drafting (Mechanical)
	26U1VSEB009	EV Architecture (Mechanical)
	26U1VSEB010	Manufacturing Practices and Fab Lab (Manufacturing)
	26U1VSEB011	Robotics and Drone Operation and Safety (Manufacturing)
2 Credits (2 Th)		
Indian Knowledge System (Domain Specific) (Compulsory)	26U1IKCL001	Indian Knowledge System (ALL Branches)

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1 Credit (1 P)		
Liberal Learning Course (Any One)	26U1LLEP008	Liberal Learning Course - Cultural Club
	26U1LLEP012	Liberal Learning Course - Drama and Film Club
	26U1LLEP029	Liberal Learning Course - Spandan Club
	26U1LLEP001	Liberal Learning Course - Arts and Crafts Club
	26U1LLEP020	Liberal Learning Course - Magazine
	26U1LLEP011	Liberal Learning Course - Debate, Quiz, Model United Nations, and Youth Parliamentary Club
	26U1LLEP015	Liberal Learning Course - Football Club
	26U1LLEP002	Liberal Learning Course - Astronomy Club
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	26U1LLEP028	Liberal Learning Course - Software Development Club
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	26U1LLEP021	Liberal Learning Course - National Service Scheme (NSS) Swayamsiddha

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Matrix Algebra and Calculus (MAC)			
Course Code	26U1BSML002	Examination Scheme	TA, MSE & ESE
Teaching Scheme	2-1-0-1 = 3	Theory	TA: 20, MSE: 30, ESE: 50
Credits	3	Laboratory	--
Course Objectives			
Necessity for the foundation of Engineering and Technology being Mathematics, the main aim is to teach mathematical methodologies and models, develop mathematical skills and enhance thinking power of students.			
Sr. No.	Course Outcome: Students will be able to		
CO1	Define matrices, linear equations, and determinants, state concepts of basic matrix algebra, limits, continuity and derivatives of functions of single variable, indefinite and definite integrals and their properties.		
CO2	Solve systems of linear equations using matrices; verify the Mean Value Theorem; find critical points and monotonicity of single-variable functions and determine extrema of several functions; evaluate Beta and Gamma integrals.		
CO3	Calculate eigenvalues, eigenvectors, rank of a matrix; find matrix that diagonalizes given matrix, find extreme values of functions; evaluate areas & volume of solids, and evaluate double & triple integrals; sketch curves.		
CO4	Prove theorems, prove properties of Beta and Gamma functions.		
CO5	Apply concepts of Matrix Algebra and Calculus to various problems including real-life problems, and Indian Knowledge Systems (IKS)-based applications.		
Syllabus:			
Unit	Contents		Hrs (L+T+S)
1.	Matrix Algebra: Properties of Matrices and Determinants; Solutions of Systems of linear equations using Gauss Elimination method; Rank of a matrix; Eigenvalues and Eigenvectors, diagonalization of special matrices; Applications. S: Properties of Matrices and Determinants		16 Hrs (8L+4T+4S)
2.	Differential Calculus: 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, concavity and curve sketching, Applied Optimization Problems. Functions of Several Variables, Partial Derivatives, The Chain Rule, Extreme Values and Saddle Points. S: Functions of single variable; Limits: Standard limits and methods of evaluation; Continuity and Differentiability		8 Hrs (4L+2T+2S)
3.	Integral Calculus: Reduction formulae, 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.		24 Hrs (12L+6T+6S)

4.	Indian Knowledge Systems (IKS) • Āryabhaṭa's Kuṭṭaka algorithm for linear indeterminate equations, paralleling the Extended Euclidean Algorithm • Bhāskarācārya's Chakravala method for Pell's equation $x^2 - Ny^2 = 1$ — recurrence matrix ($\det = 1$) as an early link to eigenvalue theory and the fundamental unit • Bhāskarācārya's extension of Kuṭṭaka to simultaneous linear congruences — an early form of the Chinese Remainder Theorem, paralleling Gauss elimination • Brahmagupta's formula and Bhaskara II (7th c.) for the area of a cyclic quadrilateral, surface area of sphere, generalizing Heron's formula— early exact-area computation, foundational to area/volume applications. • Powering method — repeated squaring for computing powers • Power of a matrix — extension of the powering method to matrix exponentiation	8Hrs (4S)
Learning Resources:		
No.	Textbooks	
1.	E. Kreyszig, Advanced Engineering Mathematics. Boston, MA: Wiley Eastern Ltd., 10th ed., 2011.	
2.	M. D. Weir, J. Hass, F. R. Giordano, Thomas's Calculus. Boston, MA: Pearson Education, 12th ed., 2010.	
No.	Reference Books/Research articles	
1.	B. S. Grewal, Higher Engineering Mathematics. New Delhi: Khanna Publishers 45 th ed.	
2.	R. Larson, D. Falvo, Elementary Linear Algebra. Boston, New York: Houghton Mifflin Harcourt, 6th ed.	
3.	S. A. Katre, "Āryabhaṭa's Method of Finding Square Roots and Cube Roots and its Generalization to Find n-th Roots," Scientiae Mathematicae Japonicae, 87(2), 2025, 147–152.	
4.	S. A. Katre, Shailaja Katre, M. Gadgil, Square Roots of Expressions in Quadratic Surds as per Bhaskaracarya, Samiksika Series 16. New Delhi: National Mission for Manuscripts, 2022.	
5.	K. Plofker, Mathematics in India. Princeton, NJ: Princeton University Press, 2009.	
6.	K. V. Sarma (tr.), Gaṇita-Yukti-Bhāṣā of Jyeṣṭhadeva, with explanatory notes. New Delhi: Springer / Hindustan Book Agency, 2008.	
7.	P. P. Divakaran, The Mathematics of India: Concepts, Methods, Connections. Singapore, New Delhi: Springer / Hindustan Book Agency, 2018.	
8.	R. Roy, "The Discovery of the Series Formula for π by Leibniz, Gregory and Nīlakanṭha," Mathematics Magazine, 63(5), 1990, 291–306.	
9.	B. Datta, A. N. Singh, History of Hindu Mathematics: A Source Book. Bombay: Asia Publishing House, 1962.	
10.	B. Mahadevan, Indian Knowledge System: Concepts and Applications. Cambridge University Press, 2022.	
11.	D. M. Bose, S. N. Sen, B. V. Subbarayappa (Eds.), A Concise History of Science in India. New Delhi: Indian National Science Academy, 1971.	
Assessment Notes:		
No.	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/IKS topics and comprehension of unseen passages.



Vector Calculus and Differential Equations (VCDE)			
Course Code	26U1BSML004	Examination Scheme	TA, MSE & ESE
Teaching Scheme	3-1-0-1 = 4	Theory	TA: 20, MSE: 30, ESE: 50
Credits	4	Laboratory	--
Prerequisite	MAC		
Course Objectives			
Necessity for the foundation of Engineering and Technology being Mathematics, the main aim is to teach mathematical methodologies and models, develop mathematical skills and enhance thinking power of students.			
No.	Course Outcome: Students will be able to		
1.	Define ordinary differential equations, Laplace transforms, inverse Laplace transforms, and Fourier series; recall basic properties and standard formulas; define vector calculus concepts, vector fields, partial differential equations and recall basic properties.		
2.	Solve first -order and higher-order ordinary differential equations; find Laplace transforms & inverse Laplace transforms; find Fourier series of standard functions; solve problems involving gradient, divergence, curl, line & surface integrals, and solve basic partial differential equations.		
3.	Solve ordinary differential equations using appropriate analytical methods; evaluate Laplace transforms, inverse Laplace transforms, and Fourier series expansions of periodic functions; solve initial and boundary value problems using Laplace transform techniques; solve partial differential equations.		
4.	Prove theorems in ODE; prove theorems and properties in Vector Calculus.		
5.	Apply concepts of ordinary differential equations, Laplace transforms, and Fourier series to solve real-life engineering and scientific problems; apply concepts of vector calculus and partial differential equations to engineering and real-life problems, and Indian Knowledge Systems (IKS)-based applications.		
Syllabus			
Unit	Contents		Hrs (L+T+S)
1.	Ordinary Differential Equations: First-order Ordinary Differential Equations: Variable Separable, Homogeneous, Linear; Higher-order linear equations with constant coefficients; Euler-Cauchy equations; Non-homogeneous equations (Undetermined Coefficients and Variation of Parameters); Laplace Transform, Inverse Laplace Transform, Properties, Applications to IVP/BVP; Fourier Series. S: First-order variable separable, homogeneous and linear differential equations.		30 Hrs. (18L+6T+6S)
2.	Vector Calculus: Vectors in 2- and 3-space, dot and cross products, vector-valued functions, gradient, directional derivatives, divergence, curl, 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 products.		15 Hrs (9L+3T+3S)

3.	Partial Differential Equations: Method of Separation of Variables; Modeling and Solutions of one-dimensional diffusion equation, first and second order one-dimensional wave equation. S: Modeling of one-dimensional diffusion equation	15 Hrs (9L+3T+3S)
4.	Indian Knowledge Systems (IKS) Indian Contributions to Differential Equations and Infinite Series (IKS) • Bhāskarācārya II — early concepts of instantaneous rate of change and motion, closely linked to differential calculus. • Mādhava of Saṅgamagrāma — infinite series for trigonometric functions, forming the basis for analytical approximations, sine and cosine series, infinite series for finding circumference. • Kerala School of Mathematics — power series and iterative computational methods for mathematical/astronomical calculations, differential calculus and series expansions, regular and semi-regular continued fractions and its applications in Indian astronomy.	8 Hrs (4S)
Learning Resources		
No.	Textbook	
1	E. Kreyszig, Advanced Engineering Mathematics. Boston, MA: Wiley Eastern Ltd., 10th ed., 2011.	
No.	Reference Books	
1.	M. D. Weir, J. Hass, F. R. Giordano, Thomas' Calculus. Boston, MA: Pearson Education, 14th ed., 2017.	
2.	K. D. Joshi, Calculus for Scientists and Engineers. Boca Raton, FL: CRC Press, 2002.	
3.	S. Ghorpade, B. Limaye, A Course in Calculus and Real Analysis. New York: Springer-Verlag, 1st ed., 2006.	
4.	P. N. Wartikar, J. N. Wartikar, Applied Mathematics, Vol. 1. Pune: Pune Vidyarthi Griha Prakashan, reprint July 2014.	
5.	K. Plofker, Mathematics in India. Princeton, NJ: Princeton University Press, 2009.	
6.	D. M. Bose, S. N. Sen, B. V. Subbarayappa (Eds.), A Concise History of Science in India. New Delhi: Indian National Science Academy, 1971.	
7.	G. G. Joseph, The Crest of the Peacock: Non-European Roots of Mathematics. Princeton, NJ: Princeton University Press, 3rd ed., 2011.	
8.	M. D. Weir, J. Hass, F. R. Giordano, Thomas' Calculus. Boston, MA: Pearson Education, 14th ed., 2017.	
Assessment Notes		
No.	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/IKS topics and comprehension of unseen passages.

PSH

Linear Algebra (LA)			
Course Code	26U1BSML001	Examination Scheme	TA, MSE & ESE
Teaching Scheme	2-1-0-1 = 3	Theory	TA: 20, MSE: 30, ESE:50
Credits	3	Laboratory	--
Course Objectives			
Necessity for the foundation of Engineering and Technology being Mathematics, the main aim is to teach mathematical methodologies and models, develop mathematical skills and enhance thinking power of students.			
No.	Course Outcome: Students will be able to		
CO1	Define matrices, linear equations & determinants; recall basic vector algebra; define linear maps & inner product spaces.		
CO2	Understand basic concepts such as vector spaces, linear dependence/independence of vectors, basis and linear maps & inner product spaces.		
CO3	Analyze and calculate eigenvalues, eigenvectors, rank and nullity of a matrix and properties of linear maps & inner product spaces.		
CO4	Prove theorems; apply the Gram–Schmidt process, and diagonalize special matrices.		
CO5	Apply concepts of linear algebra to various problems including real-life problems, and Indian Knowledge Systems (IKS)-based applications.		
Syllabus:			
Unit	Contents	Hrs (L+T+S)	
1.	Matrices and Linear Equations: 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	24 Hrs (12L+6T+6S)	
2.	Linear mappings: representation by matrices, rank-nullity theorem, eigenvalues, eigenvectors and their basic properties. S: Basic properties of eigenvalues and eigenvectors.	12 Hrs (6L+3T+3S)	
3.	Inner product spaces: orthogonality, Gram–Schmidt process, diagonalization of special matrices, geometric applications of linear transformations, quadratic forms. S: Geometric applications of linear transformations and quadratic forms.	12 Hrs (6L+3T+3S)	
4.	Indian Knowledge Systems (IKS) - Āryabhaṭa's Kuṭṭaka algorithm for linear indeterminate equations, paralleling the Extended Euclidean Algorithm - Bhāskarācārya's Chakravala method for Pell's equation $x^2 - Ny^2 = 1$ — recurrence matrix ($\det = 1$) as an early link to eigenvalue theory and the fundamental unit	8Hrs (4S)	

	- Bhāskarācārya's extension of Kuṭṭaka to simultaneous linear congruences — an early form of the Chinese Remainder Theorem, paralleling Gauss elimination Brahmagupta's formula and Bhaskara II (7th c.) for the area of a cyclic quadrilateral, surface area of sphere, generalizing Heron's formula — early exact-area computation, foundational to area/volume applications. - Powering method — repeated squaring for computing powers - Power of a matrix — extension of the powering method to matrix exponentiation	
Learning Resources:		
No.	Textbook	
1	R. Larson, D. Falvo, Elementary Linear Algebra. Boston, New York: Houghton Mifflin Harcourt Publishing Company, 6th ed.	
No.	Reference Books	
1.	E. Kreyszig, Advanced Engineering Mathematics. Boston, MA: John Wiley & Sons, 10th ed., 2011.	
2.	S. Lang, Linear Algebra. New York: Springer, 3rd ed., 1987.	
3.	G. Strang, Linear Algebra and its Applications. India: Cengage Learning, 4th ed., 2005.	
4.	H. Anton, C. Rorres, Elementary Linear Algebra. Hoboken, NJ: John Wiley and Sons, 10th ed., 2010.	
5.	T. Hayashi, The Bakhshali Manuscript: An Ancient Indian Mathematical Treatise. Groningen: Egbert Forsten, 1995.	
6.	S. A. Katre, "Aryabhata's Method of Finding Square Roots and Cube Roots and its Generalization to Find n-th Roots," Scientiae Mathematicae Japonicae, 87(2), 2025, 147–152.	
7.	K. Plofker, Mathematics in India. Princeton, NJ: Princeton University Press, 2009.	
8.	B. Datta, A. N. Singh, History of Hindu Mathematics: A Source Book. Bombay: Asia Publishing House, 1962.	
9.	S. G. Dani, "Geometry in the Śulvasūtras," in Studies in History of Mathematics, ed. C. S. Seshadri. New Delhi: Hindustan Book Agency, 2010.	
10.	G. G. Joseph, The Crest of the Peacock: Non-European Roots of Mathematics. Princeton, NJ: Princeton University Press, 3rd ed., 2010.G. G. Joseph, The Crest of the Peacock: Non-European Roots of Mathematics. Princeton, NJ: Princeton University Press, 3rd ed., 2010.	
Assessment Notes:		
No.	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/IKS topics and comprehension of unseen passages.



Probability and Statistics (PS)			
Course Code	26U1BSML003	Examination Scheme	TA, MSE & ESE
Teaching Scheme	3-1-0-1 = 4	Theory	TA: 20, MSE: 30, ESE: 50
Credits	4	Laboratory	--
Prerequisite	--		
Course Objectives			
Necessity for the foundation of Engineering and Technology being Mathematics, the main aim is to teach mathematical methodologies and models, develop mathematical skills and enhance thinking power of students.			
No.	Course Outcome: Students will be able to		
CO1	Recall and know basics of probability theory, R software, probability distribution; define estimation theory, hypothesis testing, statistical inference, regression, and recall the basic concepts of R programming.		
CO2	Understand concepts of probability, probability distributions, and use of R software; Explain and perform estimation, hypothesis testing, and regression analysis using appropriate statistical methods and R software.		
CO3	Evaluate probability of compound events, find probabilities using standard distributions; Evaluate statistical inference using confidence intervals, <i>t</i> -test, <i>z</i> -test, <i>F</i> -test, χ^2 -test, non-parametric tests, and statistical data sets in R.		
CO4	Prove theorems / statements, unstandard programs on R; apply statistical inference techniques and R programming to solve engineering problems involving estimation, hypothesis testing, and regression analysis.		
CO5	Apply concepts of probability and statistics to various problems including real life problems; apply concepts of probability, statistical inference, regression, and R programming to solve engineering and real-life data analysis problems and Indian Knowledge Systems (IKS)-based applications.		
Syllabus			
Unit	Contents		Hrs (L+T+S)
1.	Introduction to ‘R’: 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		11 Hrs (7L+2T+2S)
2.	Descriptive statistics: 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, Normal, Exponential. S: Bayes’ Rule for conditional probability		19 Hrs (11L+4T+4S)

3.	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, Multivariate Regression	30 Hrs (18L+6T +6S)
4.	Indian Knowledge Systems (IKS) Indian Contributions to Combinatorics, Probability and Data Analysis (IKS) • Piṅgala's Chandaḥśāstra — binary representation and combinatorial principles in analysis of poetic metres; Meruprastāra (Pascal's Triangle) for permutations of n things taken r at a time; metre-counting problems; Āyurvedic problem of pickle combinations using the 6 rasas. • Mahāvīracārya's formula for nC_r, and the Binomial Theorem's connection to Napier's logarithms. • Hemachandra numbers — recursive sequence with applications in counting and combinatorial patterns. • Indian Mathematical Tradition — systematic enumeration, permutations and combinations in Sanskrit prosody and mathematics.	8 Hrs (4S)

Learning Resources

No.	Textbook
1	C. Heumann, M. Schomaker, Shalabh, Introduction to Statistics and Data Analysis. Cham: Springer, 2016.
No.	Reference Books
1	S. M. Ross, Introduction to Probability and Statistics for Engineers and Scientists. Amsterdam: Elsevier Academic Press, 8th ed., 2014.
2	R. E. Walpole, S. L. Myers, K. Ye, Probability and Statistics for Engineers and Scientists. Upper Saddle River, NJ: Pearson Prentice Hall, 9th ed., 2007.
3	T. M. Davies, The Book of R: A First Course in Programming and Statistics. San Francisco, USA: No Starch Press, 1st ed., 2016.
4	K. S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Applications. New Delhi: Wiley Student Edition, 2nd ed., 2008.
5	K. Plofker, Mathematics in India. Princeton, NJ: Princeton University Press, 2009.
6	G. G. Joseph, The Crest of the Peacock: Non-European Roots of Mathematics. Princeton, NJ: Princeton University Press, 3rd ed., 2011.
7	B. Datta, A. N. Singh, History of Hindu Mathematics: A Source Book. Bombay: Asia Publishing House, 1962.
8	C. K. Raju, Cultural Foundations of Mathematics: The Nature of Mathematical Proof and the Transmission of the Calculus from India to Europe. New Delhi: Pearson Longman, 2007.

No.	Reference Books
1	N. Matloff, The Art of R Programming: A Tour of Statistical Software Design. San Francisco, CA: No Starch Press, 1st ed., 2011.
2	S. Purohit, S. Gore, S. Deshmukh, Statistics Using R. New Delhi: Narosa Publications, 2nd ed., 2019.
3	R. Pruim, Foundations and Applications of Statistics: An Introduction Using R. Providence, RI: American Mathematical Society, 2nd ed., 2018.
4	H. Wickham, G. Grolemund, R for Data Science: Import, Tidy, Transform, Visualize and Model Data. Sebastopol, CA: O'Reilly Media, 1st ed., 2017.
Assessment Notes	
No.	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/IKS topics and comprehension of unseen passages.

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Engineering Physics (Theory)			
Course Code	26U1BSPB001	Scheme of Evaluation	Marks
Teaching Plan (L-T-P-S) =TC	2-0-2-1	CIE (TA)	20
Credits	3	CIE (MSE)	30
		ESE	50
Course Outcome: Students will be able to			
1. Apply fundamental principles of quantum mechanics to one-dimensional motion of particles. 2. Determine the Fermi level positions and energy band gap of solids and categorise solids based on band structure 3. Demonstrate the application of thin film interference and diffraction in optical systems 4. Apply the concepts of lasers in engineering			
Unit	Contents		Lecture
1.	Quantum Mechanics 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),		7
2.	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		7
3.	Interference and Diffraction Interference due to wedge shaped thin film (with derivation); conditions of minima maxima, Newton's rings, Applications of interference. Fraunhofer diffraction at a single slit; condition of maxima and minima, Plane diffraction grating (Diffraction at multiple slits) and applications based on diffraction.		7
4.	Laser Physics 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).		7
5.	Indian Knowledge System (IKS) Self-study: Indian concepts of matter, dravya(substance), guṇa(property), karma(motion), anu (atom) and paramāṇu in Vaiśeṣika; concepts of space, time and motion; Indian astronomical traditions and scientific observation; historical understanding of light and celestial phenomena; astronomical instruments and measurement; comparison of traditional knowledge frameworks with modern concepts of quantum mechanics, optics, diffraction and laser technology; evolution from observation and measurement to modern optical and photonic technologies. Indian concepts and observations related to light – tejas, vision, shadows and celestial phenomena related with modern concepts of Interference, diffraction and optical phenomena		7
Suggested learning resources:			
1. D. J. Griffiths, Introduction to quantum mechanics, Pearson Prentice Hall, 2nd Edition 2. M. N. Avadhanulu, P.G. Kshirsagar, A text book of Engineering physics, S. Chand Publication, 11 th Edition 3. A. Beiser Concepts of Modern Physics, Tata McGraw – Hill Edition.			

4. C. Kittel, Introduction to Solid State Physics, Wiley Publication.
5. S. O. Pillai, Solid State Physics, New Age International Publishers, 10th Edition.
6. F. A. Jenkins and H. E. White, Fundamentals of Optics, Mc-Graw Hill, 4th Edition
7. K. Thyagarajan, A. K. Ghatak, LASERS: Theory and Applications, Macmillan India Ltd., 2nd Edition
8. Dr C. S. R. Prabhu, The Physics of Vaisesika, Sri Venkateswara Vedic University, Tirupati, Edition 2014
9. R. Sharma, K. Thakka, and K. K. Dubey, Physics in Ancient Indian Knowledge System, Journal of Technology 12, no. 12,267-280 (2024).



Course Title: Engineering Physics LAB			
Course Code	26U1BSPB001	Scheme of Evaluation	Marks
Teaching Plan (L-T-P-S) =TC	0-0-2-0	CIE	60
Credits	01	ESE	40
Course Outcomes:			
After the completion of the course, students should be able to:			
1. Demonstrate and verify phenomena of optics using experimental methods 2. Study and analyze dielectric materials using experimental methods 3. Demonstrate and verify phenomena of optics using experimental methods			
Determine the size of obstacle using laser			
List of Experiments:			
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 6. Diffraction experiment with laser 7. To determine the wavelengths of light of a given source using diffraction grating 8. Newton's Rings 9. Determine the diameter of thin wire using laser diffraction. 10. Numerical aperture of optical fiber			



Course Title: Engineering Chemistry

Course Code	26U1BSCB001	Scheme of Evaluation	TA, MSE & ESE
Teaching Plan (L-T-P-S) =TC	2-0-2-1= 3	CIE : TA+ MID Semester	20+30
Credits	3	END Semester	50
Course outcomes:			
Students will be able to:			
CO1:	Understand the fundamental concepts of analytical techniques, corrosion, electrochemical energy systems, and water technology relevant to engineering. <i>(Remember – BT Level 1)</i>		
CO2:	Explain the scientific principles governing material characterization, corrosion, electrochemical energy systems, and industrial water treatment. <i>(Understand – BT Level 2)</i>		
CO3:	Apply appropriate scientific principles and methods to solve engineering problems related to material protection, energy storage, and water treatment. <i>(Apply – BT Level 3)</i>		
CO4:	Analyze and evaluate engineering materials, analytical methods, corrosion control strategies, electrochemical energy systems, and water treatment processes to recommend suitable solutions for engineering applications. <i>(Analyze & evaluate – BT Levels 4 & 5)</i>		
Syllabus: Engineering Chemistry Theory			
Unit	Contents		L
1.	Analytical Techniques for Engineers • 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.		6
2.	Corrosion and material protection • Introduction to corrosion and its impact on engineering materials • Mechanisms of corrosion phenomena. • Types/forms of corrosion, • Factors responsible for enhancing rate of corrosion • Various corrosion prevention techniques.		6
3.	Electrochemical energy systems • Significance of energy storage systems. • Classification of high energy electrochemical energy storage systems • Battery characteristics. • New emerging batteries - principle, construction, working, advantages and applications.		6
4.	Water Technology • Sources of water and impurities are present in it. • Characteristics of hardwater -hardness in water and its determination by EDTA method and numerical. • Effects of hard water for industrial use. • Various water softening techniques for industrial use.		6



5.	Indian Knowledge System: 1. Ancient Indian Metallurgy and Materials Science: Traditional metal extraction and processing, Wootz steel, Panchaloha alloys, zinc extraction at Zawar, quality assessment of metals, corrosion resistance of the Iron Pillar of Delhi, and indigenous metal preservation techniques. 2. Traditional Indian Water, Energy and Energy Storage Systems: Traditional water purification, rainwater harvesting and water-storage systems; historical perspectives on energy generation and storage, indigenous energy materials, and electrochemical concepts associated with the <i>Agastya Samhita</i>. 3. Traditional Materials and Analytical Practices: Indigenous methods of identifying and assessing metals, minerals, dyes and pigments; traditional quality assessment of materials; and a brief comparison with modern chemical and analytical techniques	7
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Course Title: Engineering Chemistry Laboratory

Course Code	26U1BSCB001	Scheme of Evaluation	CIE & ESE
Teaching Plan (L-T-P-S) =TC	0-0-2-0 = 1	CIE	60
Credits	1	ESE- Oral+ Experiment	40
Course Outcome: Students will be able to:			
CO1:	Apply theoretical knowledge for practical use and solve engineering problems.		
CO2:	Design and carry out scientific experiments, accurately record and analyze the results of experiments.		
List of Experiments:			
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. Estimation of copper from brass by iodometry.			
5. Weight Loss Method to Determine Corrosion Rate of Iron in Different Media.			
6. Complexometric method for hardness determination of water.			
7. Determination of caustic and bicarbonate alkalinity of water sample.			
8. Precipitation method for chloride determination of water.			
9. Case Study.			
Suggested learning resources:			
[1] H. H. Willard, L. L. Merritt, J. A. Dean, and F. A. Settle, Instrumental Methods of Analysis, 7th ed. Belmont, CA, USA: Wadsworth Publishing Company, 1988.			
[2] G. R. Chatwal and S. K. Anand, Instrumental Methods of Chemical Analysis, 5th rev. and enl. ed. New Delhi, India: Himalaya Publishing House, 2002.			
[3] P. C. Jain and M. Jain, A Textbook of Engineering Chemistry, 17th ed. New Delhi, India: Dhanpat Rai Publishing Company, 2010.			
[4] S. S. Dara and S. S. Umare, A Textbook of Engineering Chemistry, 12th ed. New Delhi, India: S. Chand & Company, 2010.			
[5] S. Chawla, A Textbook of Engineering Chemistry, 3rd ed. New Delhi, India: Dhanpat Rai & Co., 2015.			
[6] J. Ma, Ed., Battery Technologies: Materials and Components. Weinheim, Germany: Wiley-VCH, 2022.			
[7] M. N. Rao and A. K. Datta, Wastewater Treatment, rev. ed. New Delhi, India: CBS Publishers & Distributors, 2018.			
[8] M. J. Hammer, Sr., and M. J. Hammer, Jr., Water and Wastewater Technology, 7th ed. Upper Saddle River, NJ, USA: Pearson Prentice Hall, 2012.			
[9] B. Mahadevan, V. R. Bhat, and R. N. Nagendra Pavana, Introduction to Indian Knowledge System: Concepts and Applications. New Delhi, India: PHI Learning Pvt. Ltd., 2022.			
[10] R. Balasubramaniam, Story of the Delhi Iron Pillar. New Delhi, India: Foundation Books, 2005.			
[11] P. C. Ray, History of Hindu Chemistry. New Delhi, India: Cosmo Publications, 2012.			
[12] S. Srinivasan and S. Ranganathan, India's Legendary Wootz Steel: An Advanced Material of the Ancient World. Bangalore, India: National Institute of Advanced Studies and Indian Institute of Science, 2004.			
[13] V. Tripathi, Ed., Archaeometallurgy in India. New Delhi, India: Sharada Publishing House, 1998.			



Quantum Physics			
Course Code	26U1BSPL001	Scheme of Evaluation	Marks
Teaching Plan (L-T-P-S) =TC	2-1-0-1	CIE (TA)	20
Credits	3	CIE (MSE)	30
		ESE	50
Course outcomes:			
After the completion of the course, students should be able to			
1. Represent and analyze quantum states and operators using Dirac Notations			
2. Apply the postulates of quantum mechanics to study the simple harmonic oscillator			
3. Analyze spin-1/2 systems and qubit operations using Pauli matrices and density matrices			
Design simple quantum circuits using quantum gates			
Unit	Contents		Lecture
1.	Mathematical tools for Quantum Physics: Review of linear vector spaces, Hilbertspace, Dirac Notations (ket and bra vectors). Operators in Hilbert space: definition, Hermitian Adjoint, projection operators, functions of operator, unitary operators, eigenvalues and eigenvectors of an operator. Commutator and anti-commutator bracket algebra. Representation in Discrete Bases: column and row matrix representation of ket and bra vectors, $N \times N$ square matrix representation of operators, change of bases and unitary transformations		7
2.	Postulates of quantum mechanics and simple harmonic oscillator problem: Basic postulates of quantum mechanics, the state of a system: probability density, superposition principle. Relation between observables and operators, measurement in quantum mechanics, expectation values, time-independent Schrodinger equation. Harmonic oscillator: energy eigenvalue and eigenstates of the Hamiltonian operator, raising and lowering operators (ladder operators), occupation number operator. Matrix representation of various operators.		7
3.	Spin-1/2 systems Spin-1/2 two-level systems: concept of electron spin and spin angular-momentum using Stern-Gerlach experiment, Pauli matrices, (anti)commutation bracket algebra of $\sigma_{\{x/y/z\}}$ matrices. Density matrix formulation and expectation values of various operators in spin-1/2 systems – for pure states and mixed states		7
4.	Quantum gates Distinction between classical and quantum bits. Bloch sphere representation of a qubit. Single qubit gates: Pauli-matrices gates, Hadamard gate, phase gate, T-gate, Multi qubit gates: CNOT, Toffoli, Controlled Z gate		7
5.	Vaisheshika Paramanu and Quantum Theory of Matter (self-study) Paramanu compare its philosophical meaning with the modern concept of atoms, elementary particles and quantum states. Akasha and the Concept of Quantum Fields Advaita Vedanta and Quantum entanglement Observer and Reality, Nyaya-Vedanta Perspectives and Quantum Measurement		7
Suggested learning resources:			
1) A. Beiser, S. Mahajan, S Rai Choudhury, Modern Physics, Tata McGraw Hill New Delhi, 2006. 6thEdition			
2) David J. Griffiths, Introduction to Quantum Mechanics, Pearson Prentice Hall, 2nd Edition			
3) P. M. Mathews, K. Venkatesan, A Textbook of Quantum Mechanics, 2nd Edition			
4) A. K. Ghatak, S. Lokanathan, Quantum Mechanics – Theory and Applications, Macmillan India Ltd, 3 rd Edition			
5) L. I. Schiff, Quantum Mechanics, McGraw-Hill, 3rd Edition			
6) J. J. Sakurai, Modern Quantum mechanics, Addison-Wesley, 2 nd Edition			
7) N. Zettili, Quantum Mechanics: Concepts and Applications, Wiley Publication, 2nd Edition			
8) Jonardon Ganeri, Philosophy in Classical India: The Proper Work of Reason			

- 9) Bimal Krishna Matilal, Perception: An Essay on Classical Indian Theories of Knowledge
- 10) Karl H. Potter, Works on Indian epistemology
- 11) Karl H. Potter, Encyclopedia of Indian Philosophies



Semiconductor Physics			
Course Code	26U1BSPL003	Scheme of Evaluation	Marks
Teaching Plan (L-T-P-S) =TC	1-0-0-1	CIE (TA)	20
Credits	1	CIE (MSE)	30
Course outcomes:			
After the completion of the course, students should be able to			
1.Calculate conductivity of intrinsic and extrinsic semiconductors.			
2.Calculate carrier concentration and electrical conductivity of the given semiconductor diode.			
Unit 1	Electrical properties of Semiconductors		[7 Hrs]
Fermi-Dirac distribution function, Electron and hole concentrations in semiconductors, Fermi level in intrinsic and extrinsic semiconductors. 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 lifetime.			
Unit 2	Physics of Semiconductors		[7 Hrs]
Hall Effect, 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, p-n junction under reverse bias, Diode equation, I-V characteristics in forward and reverse bias.			
Suggested learning resources:			
1. M. N. Avadhanulu, P.G. Kshirsagar, A text book of Engineering physics, S. Chand Pub. 11 th Edition			
2. A. Beiser; Concepts of Modern Physics, Tata McGraw – Hill, 8 th Edition.			
3. C. Kittel, Introduction to Solid State Physics, Wiley publication.			
4. S. O. Pillai, Solid State Physics, New Age International Publishers, 10 th Edition			
5. B. G. Streetman, S. Banerjee, Solid state electronic devices, Pearson Prentice-Hall, 7 th Edition			
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.			

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Electromagnetism (F.Y. B. Tech)			
Course Code	26U1BSPL002	Scheme of Evaluation	Marks
Teaching Plan (L-T-P-S) =TC	1-0-0-1	CIE (TA)	20
Credits	1	CIE (MSE)	30
Course Outcomes:			
After the completion of the course, students should 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			(7 L)
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			(7L)
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.			
References:			
1. M. N. Avadhanulu, P.G. Kshirsagar, A text book of Engineering physics, S. Chand Publication, 11 th Edition.			
2. J. D. Jackson, Classical Electrodynamics, Wiley Publishers, 3 rd Edition.			
3. D. J. Griffiths, Introduction to Electrodynamics, Springer Publication, 4 th Edition.			
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.			



BIOLOGY FOR ENGINEERS (BFE)			
Course Code	26U1BSBL001	Examination Scheme	
Teaching Plan	1-0-0-1	CIE (TA)	20
Credit/s	1	CIE (MSE)	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			
Suggested learning resources:			
1. A.L. Lehninger, D.L. Nelson & M.M. Cox, Principles of biochemistry, New York: Worth Publishers, 2000.			
2. B.R. Eggins, Biosensors: An Introduction, John Wiley & Sons Publishers, 2006.			
3. B.O. Palsson and S.N. Bhatia, Tissue Engineering, Pearson, 2009.			
4. S. Hockfield, The Age of Living Machines – How Biology Will Build the Next Technology Revolution, 2019.			

5. C. Shu, C.Y. Peter, C. Y. Chen & Y. C. Fung (Ed.) An Introductory Text to Bioengineering, World Scientific, 2000.

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	26U1BSCL001	Examination Scheme			
Teaching Scheme	1-0-0-1	CIE (TA)	20		
Credits	1	CIE (MSE)	30		
Course Outcomes: Students will be able to:					
1: Evaluate the importance, properties and innovations of next-generation batteries in electric vehicles, grid storage, and portable devices. 2: Analyse the construction and working principles of advanced batteries such as Solid-State, Lithium–Sulphur, Lithium–Air, and Sodium-Ion. 3: Apply and design chemical processes for battery recycling and metal recovery. 4: Assess hydrogen production methods, storage techniques, and safety measures for energy applications.					
Unit 1: Introduction to Advanced Batteries					[6 Hrs]
1. Importance and Innovations in next-generation batteries for EVs, grid storage, and portable devices 2. Battery properties 3. Construction, working principle of Solid-State Batteries, Lithium–Sulphur and Lithium–Air Batteries, Sodium-Ion Batteries					
Unit 2: Fuel Cells and Hydrogen Energy Systems					[6 Hrs]
1. Battery Recycling, Metal Recovery (Chemical Processes) 2. Hydrogen Production, Storage & Safety					
Unit 3: Self-study: Indian Knowledge System (IKS)					
1. Traditional Indian Knowledge in Energy storage systems and the Role of Ancient Chemists.					
Suggested References:					
[1] S. A. Arote, Lithium-Ion and Lithium-Sulfur Batteries: Fundamentals to Performance. Bristol, U.K.: IOP Publishing, 2022. [2] N. Palaniyandy, K. P. Abhilash, and B. Nalini, Eds., Solid State Batteries: Design, Challenges and Market Demands. Cham, Switzerland: Springer, 2022. [3] P. K. Tripathi, Handbook on Production, Recycling of Lithium Ion and Lead-Acid Batteries: With Manufacturing Process, Machinery Equipment Details & Plant Layout, 2nd ed. New Delhi, India: NIIR Project Consultancy Services, 2022. [4] Y. Yang, E. G. Okonkwo, G. Huang, S. Xu, W. Sun, and Y. He, “On the sustainability of lithium-ion battery industry—A review and perspective,” Energy Storage Materials, vol. 36, pp. 186–212, 2021, doi: 10.1016/j.ensm.2020.12.019. [5] Z. Dobó, T. Dinh, and T. Kulcsár, “A review on recycling of spent lithium-ion batteries,” Energy Reports, vol. 9, pp. 6362–6395, 2023, doi: 10.1016/j.egyr.2023.05.264. [6] K. Naseem, F. Qin, F. Khalid, G. Suo, T. Zahra, Z. Chen, and Z. Javed, “Essential parts of hydrogen economy: Hydrogen production, storage, transportation and application,” Renewable and Sustainable Energy Reviews, vol. 210, Art. no. 115196, 2025, doi: 10.1016/j.rser.2024.115196.					

Nanomaterials in Emerging Technologies					
Course Code	26U1BSCL002	Examination Scheme			
Teaching Scheme	1-0-0-1	CIE (TA)	20		
Credits	1	CIE (MSE)	30		
Course Outcomes: Students will be able to:					
CO1: Explain the classification, properties, synthesis techniques, and structure–property relationships of nanomaterials. CO2: Analyze the functional behavior and potential applications of nanomaterials in emerging technologies. CO3: Describe the role of nanomaterials in key application domains such as electronics, sensors, healthcare, energy, and environmental remediation. CO4: Evaluate the advantages, limitations, and sustainability considerations associated with the use of nanomaterials in engineering applications.					
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.					
Suggested learning resources:					
[1] C. P. Poole, Jr., and F. J. Owens, Introduction to Nanotechnology. Hoboken, NJ, USA: Wiley, 2003. [2] G. Cao, Nanostructures and Nanomaterials: Synthesis, Properties and Applications. Singapore: World Scientific, 2004. [3] C. N. R. Rao, A. Müller, and A. K. Cheetham, Eds., The Chemistry of Nanomaterials: Synthesis, Properties and Applications. Weinheim, Germany: Wiley-VCH, 2004. [4] M. A. Ratner and D. Ratner, Nanotechnology: A Gentle Introduction to the Next Big Idea. Upper Saddle River, NJ, USA: Prentice Hall, 2003. [5] Research articles published in IEEE Transactions on Nanotechnology, ACS Nano, Nano Letters, and Advanced Materials.					

JSK

Polymeric Materials in Engineering			
Course Code		Examination Scheme	
Teaching Scheme	1-0-0-1	CIE (TA)	20
Credits	1	CIE (MSE)	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., <i>Polymer Science</i> , New Age International.		
[2]	Billmeyer, F. W., <i>Textbook of Polymer Science</i> , Wiley.		
[3]	Young, R. J., & Lovell, P. A., <i>Introduction to Polymers</i> , CRC Press.		
[4]	Callister, W. D., <i>Materials Science and Engineering: An Introduction</i> , Wiley – Chapters on polymers.		
[5]	Raman, V., & Chawla, S., <i>Plastics Technology Handbook</i> , Khanna Publishers.		
[6]	Recent Articles from Polymer Engineering and Science and Journal of Applied Polymer Science.		

Foundation of Quantum Physics			
Course Code		Examination Scheme	
Teaching Scheme	1-0-0-1	CIE (TA)	20
Credits	1	CIE (MSE)	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.		

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Basics of Civil Engineering					
Course Code	26U1ESEL001	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] S. P. Arora and S. P. Bindra, *Building Construction*, 5th Edition, Dhanpat Rai Publications, Delhi, 2015.
- [2] S. K. Duggal, *Surveying, Volume I*, 4th Edition, Tata McGraw-Hill Education, New Delhi, 2013.
- [3] R. Singh, *Watershed Planning and Management*, 3rd Edition, Yash Publishing House, Jaipur, India, 2016.
- [4] B. C. Punmia, A. K. Jain, and A. K. Jain, *Soil Mechanics and Foundations*, 19th Edition, Laxmi Publications, New Delhi, 2026.
- [5] M. G. Shah, C. M. Kale, and S. Y. Patki, *Building Design and Drawing*, 5th Edition, Tata McGraw-Hill Education, New Delhi, 2011.
- [6] S. K. Garg, *Water Resources Engineering, Volume I*, Khanna Publishers, New Delhi, 2017.
- [7] S. K. Garg, *Water Resources Engineering, Volume II*, Khanna Publishers, New Delhi, 2017.
- [8] B. C. Punmia, A. K. Jain, and A. K. Jain, *Water Supply Engineering*, 2nd Edition, Laxmi Publications, New Delhi, 2016.
- [9] B. C. Punmia, A. K. Jain, and A. K. Jain, *Wastewater Engineering and Air Pollution*, 1st Edition, Laxmi Publications, New Delhi, 2017.

Reference Books:

- 1. E. M. Tideman, *Watershed Management: Guidelines for Indian Conditions*, 1st Edition, Omega Scientific Publishers, New Delhi, 1996.
- 2. S. Kumar, *Building Construction*, 20th Edition, Standard Publishers Distributors, New Delhi, 2018.



Fundamentals of Physical Infrastructure					
Course Code	26U1ESEL009	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)



AI for Multidisciplinary Applications						
Course Code	26U1ESEL002		Examination Scheme			
Teaching Scheme	3-0-0-1		MSE	30	ESE	50
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]	S. Russell and P. Norvig, <i>Artificial Intelligence: A Modern Approach</i> , 4th ed. Pearson, 2020.					
[2]	P. Xiao, <i>Artificial Intelligence Programming with Python</i> , 1st ed. Wiley, 2022.					
Reference Books:						
[1]	D. L. Poole and A. K. Mackworth, <i>Artificial Intelligence: Foundations of Computational Agents</i> , 3rd ed. Cambridge University Press, 2023.					
[2]	R. S. Sutton and A. G. Barto, <i>Reinforcement Learning: An Introduction</i> , 2nd ed. A Bradford Book, 2018.					
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						
Course Code	26U1ESEL004	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:						

1. Malvino, A.P., and Bates, D.J. Electronic Principles, McGraw Hill Education, 7th Edition, 2017.
2. Floyd, T.L. Electronic Devices, Pearson Education, 9th Edition, 2012.
3. Jain, R.P. Modern Digital Electronics, McGraw Hill Education, 4th Edition, 2010.
4. Frenzel, L.E. Principles of Electronic Communication Systems, McGraw Hill Education, 3rd Edition, 2012.

Reference Books:

1. Sedra, A.S., and Smith, K.C. Microelectronic Circuits, Oxford University Press, 7th Edition, 2014.
2. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Pearson Education, 4th Edition, 2001.
3. Mazidi, M.A., Mazidi, J.G., and McKinlay, R.D. The 8051 Microcontroller and Embedded Systems, Pearson Education, 2nd Edition, 2006.
4. Anand Kumar, A. Fundamentals of Digital Circuits, PHI Learning, 4th Edition, 2016.



Electrical Energy Utilization			
Course Code	26U1ESEL003	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, <i>Generation, Distribution and Utilization of Electrical Energy</i> . New Delhi, India: New Age International Publishers, 2017.		

[2]	J. B. Gupta, <i>Utilization of Electric Power and Electric Traction</i> . New Delhi, India: S. K. Kataria & Sons, 2022.
[3]	S. L. Uppal and G. C. Garg, <i>Electrical Wiring Estimating & Costing</i> , 6th ed. New Delhi, India: Khanna Publishers, 2025.
[4]	H. Pratap, <i>Art and Science of Utilization of Electrical Energy</i> . New Delhi, India: Dhanpat Rai & Sons, 2016.
[5]	R. Barnett, <i>Commercial and Industrial Wiring</i> , 2nd ed. Orland Park, IL, USA: American Technical Publishers, 2013.
Reference Books:	
[1]	B. L. Theraja and A. K. Theraja, <i>A Textbook of Electrical Technology</i> , vol. II: AC & DC Machines, Utilization & Electrical Engineering, 24th ed. New Delhi, India: S. Chand & Company Ltd., 2024.
[2]	S. C. Tripathy, <i>Electrical Power Utilization</i> . New Delhi, India: McGraw Hill Education, 1991
[3]	W. C. Turner and S. Doty, <i>Energy Management Handbook</i> , 8th ed. Lilburn, GA, USA: Fairmont Press, 2018.
[4]	D. Beeman, <i>Industrial and Commercial Power Systems Handbook</i> . New York, NY, USA: 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, <i>Commercial and Residential Energy Efficiency Resources</i> https://www.energy.gov/
[3]	NPTEL online course, <i>Illumination Engineering</i> – IIT Madras https://nptel.ac.in/
[4]	National Digital Library of India (NDLI), <i>Electrical Safety and Installation Resources</i> https://ndl.iitkgp.ac.in/ <u>Electrical Engineering Portal, Earthing and Grounding Systems</u> https://electrical-engineering-portal.com/ https://cloud.google.com/ai

Dr. K.

Fundamentals of Measurement and Sensors					
Course Code	26U1ESEL005	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:					
[1] A. K. Sawhney, <i>Electrical and Electronic Measurements and Instrumentation</i> . New Delhi: Dhanpat Rai and Sons, 2005, 12th Edition. [2] B. C. Nakra and K. K. Choudhary, <i>Instrumentation, Measurements and Analysis</i> . New Delhi: Tata McGraw Hill Education, 2016, 4th Edition.					
Reference Books:					
[1] E. O. Doebelin, <i>Measurement Systems</i> . New Delhi: McGraw Hill, 2017, 6th Edition. [2] D. Patranabis, <i>Principles of Industrial Instrumentation</i> . New Delhi: Tata McGraw Hill, 1999, 2 nd Edition. [3] A. J. Bouwens, <i>Digital Instrumentation</i> . New York: McGraw-Hill, 2008, 6th Reprint. [4] H. S. Kalsi, <i>Electronic Instrumentation</i> . New Delhi: Tata McGraw Hill, 2017, 4th Edition. [5] A. D. Helfrick and W. D. Cooper, <i>Modern Electronic Instrumentation and Measurement Techniques</i> . New Delhi: Prentice Hall, 1990, 2nd Edition.					

Foundations in Mechanical Engineering					
Course Code	26U1ESEL006	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)					
Text Books					

[1] Rajput, R.K., Basic Mechanical Engineering, Laxmi Publications Pvt. Ltd, 2010

Reference Books:

[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] Yunus A. Cengel & Boles, Thermodynamics, Tata McGraw-Hill Publisher Co. Ltd., 2001

[4] Arora and Domkunwar, Thermal Engineering, Dhanpat Rai and Sons., 2009

[5] Rayner Joel, Basic Engineering *Thermodynamics*, Pearson Education, 2008

[6] V. B Bhandari, Design of machine elements, Tata McGraw-Hill Publisher Co. Ltd., 2010

[7] V. Ganeshan, Internal Combustion Engines, McGraw Hill Publisher Co. Ltd., 2018

[8] G.D. Rai , Non-conventional Energy Sources, Khanna Publications , 6th Edition



Nanomaterials					
Course Code	26U1ESEL008	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:					
S. Lindsay, Introduction to Nanoscience. Washington, DC, USA: American Chemical Society, 2010. R. K. Goyal, Nanomaterials and Nanocomposites: Synthesis, Properties, Characterization Techniques and Applications. Boca Raton, FL, USA: CRC Press, 2017. B. S. Murty, P. Shankar, B. Raj, B. B. Rath, and J. Murday, Textbook of Nanoscience and Nanotechnology. Hyderabad, India: Universities Press, 2013.					

Basics of Manufacturing Technology					
Course Code	26U1ESEL007	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					
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 & References:

1. S. K. Hajra Choudhury, A. K. Hajra Choudhury, and S. K. Bose, *Elements of Workshop Technology*, Vols. I and II. Mumbai: Media Promoters & Publishers.
2. P. N. Rao, *Manufacturing Technology*, Vols. I and II. New Delhi: Tata McGraw-Hill.
3. W. A. J. Chapman, *Workshop Technology*, Vols. I-III. London: Edward Arnold.
4. S. K. Hajra Choudhury and S. K. Bose, *Elements of Workshop Technology*, Vols. I and II. New Delhi: Asia Publishing House.
5. R. K. Jain, *Engineering Metrology*. New Delhi: Khanna Publishers.
6. HMT, *Production Technology*. New Delhi: Tata McGraw-Hill Publishing Company, 1985.

Course Outcomes

- CO1 Explain the principles and processes of casting and metal forming.
- CO2 Explain the working principles and applications of conventional machining processes.
- CO3 Describe various joining processes and select suitable methods for given applications.
- CO4 Explain sheet metal working, PCB surface treatment, and adhesive bonding processes.
- CO5 Explain the principles, classification, components, and applications of NC/CNC machines and industrial robots.
- CO6 Apply the principles of measurement, limits, fits, tolerances, and surface finish for inspection of manufactured components.



Applied Mechanics					
Course Code	26U1ESEB001	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]	R. C. Hibbeler, <i>Engineering Mechanics: Statics</i> , 14th Edition, Pearson, 2019.				
[2]	R. C. Hibbeler, <i>Engineering Mechanics: Dynamics</i> , 14th Edition, Pearson, 2019.				
[3]	F. P. Beer, E. R. Johnston, D. Mazurek, P. J. Cornwell, and B. Self, <i>Vector Mechanics for Engineers: Statics and Dynamics</i> , 12th Edition, McGraw-Hill Education, 2019.				
Reference Books:					
[1]	J. L. Meriam, L. G. Kraige, and J. N. Bolton, <i>Engineering Mechanics: Statics</i> , 8th Edition, Wiley, 2014.				
[2]	J. L. Meriam, L. G. Kraige, and J. N. Bolton, <i>Engineering Mechanics: Dynamics</i> , 8th Edition, Wiley, 2015.				
[3]	A. Bedford and W. Fowler, <i>Engineering Mechanics: Statics and Dynamics</i> , 6th Edition, Pearson, 2023.				
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.					

- | | |
|--|---|
| | <ol style="list-style-type: none">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 method4. 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						
Course Code	26U1ESEB002		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]	N. Godbole and S. Belpure, <i>Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives</i> . Wiley.					
[2]	V. K. Pachghare, <i>Cryptography and Information Security</i> , 3rd ed. PHI Learning, ISBN: 978-93-893-4710-4.					
Reference Books:						
[1]	J. Graham, R. Howard, and R. Otson, <i>Cyber Security Essentials</i> . CRC Press, 2010.					

[2]	C.-H. Wu and J. D. Irwin, <i>Introduction to Cyber Security</i> . CRC Press, Taylor & Francis Group, 2013
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.swavam2.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.) Case Study: A recent cybercrime incident in India (e.g., online banking fraud) and present the type of crime and its impact. [8] Use Wireshark to capture network packets and observe the difference between a message sent without encryption (plain text) and with encryption (protected).	

Basic Electrical Engineering						
Course Code	26U1ESEB003		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, <i>Basic Electrical Engineering</i> , 2nd ed. New Delhi, India: McGraw Hill, 2019.						
[2] D. P. Kothari and I. J. Nagrath, <i>Basic Electrical Engineering</i> , 4th ed. New Delhi, India: Tata McGraw-Hill, 2019.						
[3] E. Hughes, <i>Electrical and Electronics Technology</i> , 10th ed. Harlow, U.K.: Pearson, 2010.						
Reference Books:						

[1] V. Del Toro, *Electrical Engineering Fundamentals*, 2nd ed. New Delhi, India: Prentice Hall India, 2015.

[2] L. S. Bobrow, *Fundamentals of Electrical Engineering*, 2nd ed. New York, NY, USA: Oxford University Press, 2003.

Basic 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. 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						
Course Code	26UIESEB004		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, 4th ed. New Delhi, India: Tata McGraw-Hill.						
2. A. Anand Kumar, Fundamentals of Digital Circuits, 4th ed. New Delhi, India: PHI Learning.						
Reference Book:						
1. M. M. Mano and M. D. Ciletti, Digital Design, 4th ed. Pearson.						
2. T. L. Floyd, Digital Fundamentals, 11th ed. Pearson.						

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	26UIESEB005	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, Engineering Drawing, Charotar Publishing House ,2011.					
[2] M.L.Dabhade , Engineering Graphics I and II , Vision Publications,2004					
Reference Books:					
[1] Warren Luzzader, Jon M. Duff, Fundamentals of Engineering Drawing, Pearson Education,2008					
[2] M.B.Shah , B.C.Rana , Engineering Drawing, Pearson Education ,2008					
[3] Dhananjay A. Jolhe, Engineering Drawing with an introduction to AutoCAD, Tata McGraw Hill Publishing Company Limited, 2008.					

Course Title: Engineering Graphics Laboratory
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Course Outcome: students will be able to

- | |
|---|
| <ol style="list-style-type: none">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.
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Assignment 2:

Draw isometric view for given orthographic views.

Assignment 3:

Draw the development lateral surfaces of solids.
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Draw 02 examples on following assignment using CAD software
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Assignment 4:

Draw orthographic views of any machine elements along with sectional view.
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Fundamentals of Corrosion Engineering					
Course Code	26U1ESEB007	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) M. G. Fontana, <i>Corrosion Engineering</i> , 3rd ed. New York, NY, USA: McGraw-Hill, 2005. 2) R. W. Revie and H. H. Uhlig, <i>Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering</i> , 4th ed. Hoboken, NJ, USA: John Wiley & Sons, 2008.					
Reference Books:					
1) S. D. Cramer and B. S. Covino, Jr., Eds., <i>ASM Handbook, Vol. 13B: Corrosion—Fundamentals, Testing, and Protection</i> . Materials Park, OH, USA: ASM International, 2010. 2) D. G. Kolman, <i>Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering</i> . Materials Park, OH, USA: ASM International, 2017. 3) NPTEL, "Corrosion Science," NPTEL course modules.					



Fundamentals of Corrosion Engineering (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	26U1ESEB006		Examination Scheme			
Teaching Scheme	2-0-2-1		MSE	30	CIE	100
Credits	3		CIE	20		
			ESE	50		
Course Outcomes:						
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4. A. Gebhardt, *Understanding Additive Manufacturing: Rapid Prototyping – Rapid Tooling – Rapid Manufacturing*. Munich, Germany: Hanser, 2011.
5. D. T. Pham and S. S. Dimov, *Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling*, 1st ed. London: Springer, 2001.

List of Assignments for Product **Prototyping Practices Lab**

Assignments	List of Assignments	Hrs
01	Introduction to New Product Development, conceptualization of POC	2 Hrs
02	Study of CAD Modelling and Digital Prototyping	2 Hrs
03	Study of Additive Manufacturing Technology, Classification of Additive Manufacturing, Additive Manufacturing Process Flow	2 Hrs
04	Printing of 3D components on FDM printer	2 Hrs
05	Demonstration of Conventional Manufacturing Process-Turning, Milling, Welding, Fitting	2 Hrs
06	Demonstration of Conventional Prototyping Process-Carpentry, Tin Smithy,	2 Hrs
07	Demonstration of FAB Lab- LASER Engraver and CNC Wood Router	2 Hrs
08	Application Oriented Case Study	2 Hrs



Engineering Exploration					
Course Code	26U1VSCP001	Examination Scheme			
Teaching Scheme:	0-0-6-0	Theory	TA: 0	MSE: 0	ESE: 0
Credits	3	Laboratory	CIE:100	ESE:0	--
Course Outcomes: At the end of the course, the students can:					
1. Understand engineering problems and formulate appropriate problem statements considering user needs and constraints.					
2. Apply systematic engineering design methods to generate, evaluate, and select concepts for practical solutions.					
3. Develop functional prototypes using appropriate mechanisms, components, sensors, actuators, and platform-based technologies.					
4. Use engineering tools to model, simulate, measure, analyze, test, troubleshoot, and improve prototype performance.					
5. Demonstrate effective teamwork, project management, technical communication, ethical practice, safety, and sustainability in engineering projects.					
Module 1: Introduction to Engineering and Engineering Study					[8 Hours]
Introduction to Engineering and Engineering Study: Difference between science and engineering, scientist and engineer, needs and wants, various disciplines of engineering, some misconceptions of engineering, Expectation from the 21st century engineer and Graduate Attributes.					
Introduction to GitHub: Git and GitHub concepts; repository creation and management README and project documentation; basic Git workflow for adding, committing and pushing code, Introduction to branches, Issues, and Wiki for project collaboration, task tracking, and documentation.					
Module 2: Engineering Ethics					[6 Hours]
Identifying engineering as a profession, significance of professional ethics, code of conduct for engineers; ethical dilemmas in engineering; case studies, ethical decision-making; intellectual property and plagiarism.					
Module 3: Sustainability in Engineering					[6 Hours]
Introduction to sustainability, Sustainability leadership, resource and energy efficiency, Life cycle assessment, carbon footprint, sustainable materials and processes.					
Module 4: Design Thinking and Ideation					[12 Hours]
Engineering Design Process, Problem definition formulation process, DFX principles, Innovation techniques using SCAMPER, Concept generation - Function tree, Functional structure, Morphological chart, and Concept selection - Pugh Chart, Product Architecture, Prototyping and testing, Introduction to CAD software, sketching, part design, and 3D modelling.					
Module 5: Mechanisms and Resource Specifications					[12 Hours]
Introduction to machines, types of motion, mechanism, types of mechanism, degree of freedom, linkages, four-bar linkage mechanism, torque, governing equations, Factor of Safety, motor sizing, motor selection, mass acquisition using software, Introduction to Linkages software.					
Module 6: Platform-based Development					[14 Hours]
Introduction to various platform-based development ESP 32/ Arduino programming using C/C++/Python and its essentials, Introduction to sensors, transducers, actuators and its interfacing with microcontroller, power adapters, types of adapters, power calculations, adapter selection.					
Module 7: Project Management					[6 Hours]
Introduction to project management, planning and scheduling; teamwork, roles and responsibilities; Agile practices and iterative development, including Scrum; work breakdown structure, Gantt chart, task allocation, progress and milestone tracking; risk identification and mitigation; project documentation.					

Module 8: Virtual Modelling and Implementation		[8 Hours]
Introduction to virtual modelling and implementation of engineering designs, mechanisms, and platform-based systems using appropriate software tools; assembly, system simulation, and virtual testing; analysis and optimization of engineering designs and prototypes.		
Module 9: Project Completion and Documentation		[12 Hours]
Final integration and refinement of the developed prototype; performance testing, troubleshooting, validation and optimization; completion of project documentation including design files, source code, test results and GitHub repository; preparation of technical report.		
Reference Books:		
[1]	A. R. Eide, R. Jenison, L. L. Northup and S. Mickelson, <i>Engineering Fundamentals and Problem Solving</i> , McGraw-Hill Higher Education, 6th Edition, 2011	
[2]	C. L. Dym and P. Little, <i>Engineering Design: A Project-Based Introduction</i> , John Wiley & Sons, 2nd Edition, 2004.	
[3]	T. E. Graedel and B. R. Allenby, <i>Industrial Ecology and Sustainable Engineering</i> , Pearson, 1st Edition, 2010.	
[4]	M. Govindarajan, S. Natarajan and V. S. Senthil Kumar, <i>Engineering Ethics: Includes Human Values</i> , PHI Learning, New Delhi, 2004.	



Fundamentals of Electrical Engineering						
Course Code	26U1EECB001		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.



Geomatic Engineering					
Course Code	26UIVSEB001	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] T. P. Kanetkar and S. V. Kulkarni, <i>Surveying and Levelling – Part 1</i>, Pune Vidyarthi Griha Prakashan, Pune, 2017. [2] T. P. Kanetkar and S. V. Kulkarni, <i>Surveying and Levelling – Part 2</i>, Pune Vidyarthi Griha Prakashan, Pune, 2019.					

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Reference books:

- [1] S. K. Duggal, *Surveying, Vol. I*, 5th Edition, Tata McGraw-Hill Education, New Delhi, 2020.
- [2] S. K. Duggal, *Surveying, Vol. II*, 5th Edition, Tata McGraw-Hill Education, New Delhi, 2019.
- [3] A. Bannister, S. Raymond, and R. Baker, *Surveying*, 7th Edition, Pearson Education, 1998.
- [4] R. Subramanian, *Surveying and Levelling*, 2nd Edition, Oxford University Press, New Delhi, 2012.
- [5] D. Clark, *Plane and Geodetic Surveying for Engineers, Vol. I*, 6th Edition, CBS Publishers and Distributors, New Delhi, 1971.
- [6] D. Clark, *Plane and Geodetic Surveying for Engineers, Vol. II*, 6th Edition, CBS Publishers and Distributors, New Delhi, 1971.
- [7] J. Clendinning, *Principles of Surveying*. Blackie.
- [8] B. C. Punmia, A. K. Jain, and A. K. Jain, *Surveying, Vol. I*, 17th Edition, Laxmi Publications, New Delhi, 2016.
- [9] B. C. Punmia, A. K. Jain, and A. K. Jain, *Surveying, Vol. II*, 17th Edition, Laxmi Publications, New Delhi, 2024.

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.) |



Fundamentals of Construction Practices					
Course Code	26U1VSEB002	Examination Scheme			
Teaching Scheme	1-0-2-1	CIE	20	CIE	50
Credits	2	ESE	30		
Course Outcomes: Students will be able to:					
1. <i>Demonstrate</i> 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] S. Kumar, <i>Building Construction</i>, 20th Edition, Standard Publishers Distributors, New Delhi, 2026. [2] S. C. Rangwala, <i>Construction of Structures and Management of Works</i>, 5th Edition, Charotar Publishing House Pvt. Ltd., Anand, 2018. [3] Bureau of Indian Standards, <i>National Building Code of India 2016</i>, SP 7:2016, Bureau of Indian Standards, New Delhi, 2016. [4] Bureau of Indian Standards, <i>National Building Code of India 2016, Part 7: Construction Management, Practices and Safety, Section 5: Repairs, Retrofitting and Strengthening of Buildings</i>, Bureau of Indian Standards, New Delhi, 2016.					
Reference Books:					
[1] B. C. Punmia, A. K. Jain, and A. K. Jain, <i>Building Construction</i>, Laxmi Publications, New Delhi. [2] S. C. Rangwala, <i>Building Construction</i>, Charotar Publishing House Pvt. Ltd., Anand					

- [3] M. S. Shetty, *Concrete Technology: Theory and Practice*, S. Chand and Company Pvt. Ltd., New Delhi.
- [4] S. K. Duggal, *Building Materials*, New Age International Publishers, New Delhi.
- [5] Bureau of Indian Standards, *National Building Code of India 2016, Part 12: Asset and Facility Management*, SP 7:2016, Bureau of Indian Standards, New Delhi, 2016.

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



Programming for problem solving						
Course Code	26U1VSEB003		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 programming 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. Pearson Education.					
[2]	B. Balagurusamy, Programming in ANSI C, 9th ed. McGraw Hill.					
Reference Books:						
[1]	S. G. Krantz, Problem Solving Techniques. Universities Press.					
[2]	M. Sprankle, Problem Solving and Programming Concepts. Pearson Education, ISBN: 978-81-317-0711-1.					
[3]	B. W. Kernighan and D. M. 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.



Web Design						
Course Code	26UIVSEB004		Examination Scheme			
Teaching Scheme	1-0-2-1		ESE	30	CIE	50
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]	J. N. Robbins, <i>Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics</i> , 5th ed. O'Reilly Media, 2018, ISBN: 978-1491960202.					
Reference Books:						
[1]	J. Duckett, <i>HTML & CSS: Design and Build Websites</i> , 1st ed. Wiley, 2014, ISBN: 978-1118008188.					
[2]	J. Duckett, <i>JavaScript and jQuery: Interactive Front-End Web Development</i> , 1st ed. Wiley, 2014, ISBN: 978-1118531648.					
[3]	M. Haverbeke, <i>Eloquent JavaScript</i> , 4th ed. No Starch Press, 2024, ISBN: 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 <code><!DOCTYPE></code> , <code><html></code> , <code><head></code> , <code><title></code> , and <code><body></code> . Add headings, a paragraph, and apply text formatting like bold , <i>italic</i> , 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.
[4]	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.
[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 <code><style></code> 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 <code><div></code> 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.	

Python Programming						
Course Code	26U1VSEB005		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, <i>How to Solve It by Computer</i> . Pearson Education, ISBN: 0-13-433995-9.					
[2]	M. Sprankle, <i>Problem Solving and Programming Concepts</i> . Pearson Education, ISBN: 978-81-317-0711-1.					
[3]	A. Sweigart, <i>Automate the Boring Stuff with Python: Practical Programming for Total Beginners</i> . No Starch Press, ISBN: 978-1-59327-599-0.					
[4]	J. M. Zelle, <i>Python Programming: An Introduction to Computer Science</i> . Franklin, Beedle & Associates, ISBN: 978-1-59028-275-5.					
Reference Books:						
[1]	S. G. Krantz, <i>Problem Solving Techniques</i> . Universities Press.					
[2]	R. Thareja, <i>Python Programming: Using Problem Solving Approach</i> , 1st ed. Oxford University Press, ISBN: 978-0-199480-173.					

[3]	W. McKinney, <i>Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython</i> . 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. 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.	



Electrical Maintenance and Safety						
Course Code	26U1VSEB006		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, <i>Electrical Wiring Estimating & Costing</i> . New Delhi, India: Khanna Publishers, 2010.					
[2]	H. Pratap, <i>Art and Science of Utilization of Electrical Energy</i> . New Delhi, India: Dhanpat Rai & Sons, 2009.					
Reference Books:						
[1]	Bureau of Indian Standards, "IS Standards," [Online]. Available: BIS online standards portal. [Accessed: Sep. 7, 2026].					
[2]	Switchgear Industry, <i>Technical Manual of Switchgear Industry</i> . [Technical manual].					
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.



Electrical Workshop						
Course Code	26U1VSEB012		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]	S. L. Uppal and J. B. Gupta, <i>Electrical Wiring Estimating and Costing</i> . New Delhi, India: S. K. Kataria & Sons, 2012.					
[2]	V. K. Mehta and R. Mehta, <i>Basic Electrical Engineering</i> , rev. ed. New Delhi, India: S. Chand Publishing, 2012.					
[3]	R. S. Khandpur, <i>Printed Circuit Boards: Design and Technology</i> . New Delhi, India: Tata McGraw-Hill Education, 2005.					
Reference Books:						
[1]	Bureau of Energy Efficiency, <i>Guidebooks for National Certification Examination for Energy Manager/Energy Auditors: General Aspects</i> . New Delhi, India: Bureau of Energy Efficiency, n.d. [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 Installation and connection of inverter/UPS with battery for domestic wiring
[9]	Connect solar panel for given AC and DC load
[10]	Energy Audit or Power Quality Audit of Commercial building/Small
[11]	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	26U1VSEB013		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.						
Textbook						
1. N. Nilekani and V. Shah, Rebooting India: Realizing a Billion Aspirations. New Delhi, India: Penguin Random House India, 2015.						
Reference Book /Reports						

1. World Bank, Digital Public Infrastructure: Safe, Trusted, Inclusive. Washington, DC, USA: World Bank, 2023.
2. Ministry of Electronics and Information Technology (MeitY), Government of India, India Digital Ecosystem Reports, 2021–2023. New Delhi, India: MeitY, 2023.
3. United Nations Development Programme (UNDP) and GovTech, Digital Public Infrastructure: A Shared Resource for Sustainable Development. New York, NY, USA: UNDP, 2022.

Online Documentation
India Stack, India Stack Documentation. [Online]. Available: https://indiastack.org



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	26U1VSEB014		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, visual 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						
Textbook and References:						

1. J. Schwabish, Better Data Visualizations: A Guide for Scholars, Researchers, and Wonks. New York, NY, USA: Columbia University Press, 2021.
2. M. Chen, H. Hauser, P. Rheingans, and G. Scheuermann, Foundations of Data Visualization. Cham, Switzerland: Springer, 2020.
3. A. Kirk, Data Visualisation: A Handbook for Data-Driven Design. London, U.K.: SAGE Publications, 2019.
4. A. C. Telea, Data Visualization: Principles and Practice. Boca Raton, FL, USA: CRC Press, 2014.
5. S. Few, Information Dashboard Design: Displaying Data for At-a-Glance Monitoring, 2nd ed. Burlingame, CA, USA: Analytics Press, 2013.
6. B. Fry, Visualizing Data: Exploring and Explaining Data with the Processing Environment. Sebastopol, CA, USA: O'Reilly Media, 2008.
7. S. García, J. Luengo, and F. Herrera, Data Preprocessing in Data Mining. Cham, Switzerland: Springer, 2014.
8. P.-N. Tan, M. Steinbach, and V. Kumar, Introduction to Data Mining, 2nd ed. Boston, MA, USA: Pearson Addison-Wesley



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 source 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. <u>Kalilur Rahman</u>, '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	26U1VSEB007	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 automate industrial applications.					
Unit 1: Introduction to PLC					[5 Hrs]
Role of automation in Industries, benefits of automation, Necessity of PLC, History and evolution of PLC, Definition, types, selection criterion, Overall PLC system, functions of Input and output modules, specifications					
Unit 2: PLC Programming					[4 Hrs]
PLC programming fundamentals, Examine-if-closed, Examine-if-open, latching, ladder logic for AND, OR, NOR, NAND logical function, Timer and counter instructions, arithmetic and advance instructions					
Unit 3: Applications of PLC					[5 Hrs]
I/O interfacing, communication protocols, logic implementations for Motor Sequencing Operation, Motor Control Center, Tank level control, Car parking, bottle filling plant, Object sorting, trouble shooting					
Textbooks:					
[1] G. Dunning, <i>Introduction to Programmable Controllers</i> . Singapore: Thomson Asia Pte. Ltd., 2002, 2nd Edition. [2] J. R. Hackworth and F. D. Hackworth Jr., <i>Programmable Logic Controllers: Programming Methods and Applications</i> . Pearson Education, 2005, 3rd Edition. [3] P. K. Srivastava, <i>Programmable Logic Controllers with Applications</i> . New Delhi: BPB Publications, 2001, 1st Edition. [4] L. A. Bryan and E. A. Bryan, <i>Programmable Controllers: Theory and Implementation</i> . Industrial Text Company Publication, 1998, 2nd Edition.					
List of Experiments					
1. Study hardware and software used in PLC 2. Implementation Logic Gates 3. Implementation of DOL Starter 4. Implementation of On-Delay and Off-delay Timer 5. Implementation of Wye-delta starter 6. Implementation of Up-Down Counter 7. Implementation of PLC Arithmetic Instructions 8. Logic implementation for motor sequencing operation 9. Logic implementation for bottle filling application 10. Logic implementation for object sorting application/ batch processing plant					

Computer Aided Drafting					
Course Code	26UIVSEB008	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] K. Kumar, A.K. Roy and C. Ranjan, Engineering Graphics and Design, Vikas Publishing House Pvt. Ltd, Noida, 1st Edition, 2018. [2] K. Venugopal, Engineering Drawing and Graphics + AutoCad, New Age International Publishers, New Delhi, 4 th Edition,					
Reference Books:					
[1] Dhananjay A. Jolhe, Engineering Drawing with an introduction to AutoCAD, Tata McGraw Hill Publishing Company Limited, 2008. [2] S.N. Lal, Engineering Drawing with an introduction to AutoCAD. Cengage Learning India Pvt. Ltd, Delhi, 2018.					

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.	



Electric Vehicle architecture					
Course Code	26U1VSEB009	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.					
Text Books					
[1] J. Larminie and J. Lowry, Electric Vehicle Technology Explained. Chichester: John Wiley & Sons, 2nd Edition, 2012. [2] M. Ehsani, Y. Gao, S. Longo, and K. Ebrahimi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles. Boca Raton: CRC Press, 3rd Edition, 2018. [3] K. Singh, Automobile Engineering, Vol. 1. New Delhi: Standard Publishers Distributors, 14th Edition, 2017.					
Reference Books					
[1] D. Andrea, Battery Management Systems for Large Lithium-Ion Battery Packs, Boston: Artech House, 2010. [2] J. D. Halderman, Automotive Chassis Systems. Pearson Education, 8th Edition, 2020. [3] W. H. Crouse and D. L. Anglin, Automotive Mechanics. New York: McGraw-Hill, 10th Edition.					

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



Introduction to Materials Modeling					
Course Code		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 (CH₄) 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.					

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- 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>



MODERN CHEMICAL ANALYSIS					
Course Code		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, 8 th ed., Khanna Publishers, New Delhi, 2009. 2. Dean J.A., Merritt L. L., Settle F.A., Williard H.H., Instrumental methods of Analysis 7 th edition, CBS Publishers & Distributors, New Delhi, 2009. 3. Vogel, Quantitative Inorganic Analysis, 7 th edition, PEARSON EDUCATION, Prentice hall, 2010					

Manufacturing Practices and Fab Lab-I (MPF-I)					
Course Code	26U1VSEB010	Examination Scheme			
Teaching Scheme	1-0-2-1	MSE	--	CIE	50
		CIE	20		
Credits	2	ESE	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:					[02 Hrs]
Workshop Orientation, Safety & 5S: workshop areas, PPE, machine safety, hazard identification, emergency procedures, 5S and sustainable workshop practices.					
Module II:					[02 Hrs]
Wood Working & Carpentry: Tools, wood/material selection, joints, marking, sawing, planing, chiseling, drilling and fabrication of a simple product.					
Module III:					[02 Hrs]
Fitting & Precision Engineering: marking, sawing, chipping, filing, drilling, tapping, precision measurement, tolerances and surface finish.					
Module IV:					[02 Hrs]
Machine & Digital Manufacturing: lathe, drilling, milling, shaper, CNC basics, CNC programming and machining process selection.					
Module V:					[02 Hrs]
Modern Metal Joining: Arc/MIG/TIG welding, gas welding/cutting, joint selection, welding defects, inspection and safety.					
Module VI: PCB Printing:					[02 Hrs]
3D Printing, Rapid Prototyping & Laser Engraving: Introduction to 3D printing and laser engraving processes, materials, and basic digital-to-physical workflow.					
Course Outcomes: At the end of the course the student will be able to learn:					
CO1: Identify and safely use workshop tools, equipment, and machines following safety, PPE, 5S, and sustainable workshop practices.					
CO2: Perform basic carpentry, fitting, and metal-joining operations using appropriate tools, materials, and standard manufacturing procedures.					
CO3: Apply fundamental machining principles to operate conventional and CNC machine tools and select appropriate manufacturing processes for simple components.					
CO4: Measure, inspect, and evaluate fabricated components using appropriate metrology techniques to assess dimensional accuracy and surface quality.					
CO5: Design and develop a simple engineering prototype by integrating conventional and digital manufacturing processes, including CNC machining, PCB fabrication.					
Suggested learning resources:					
1. S. K. Hajra Choudhury, A. K. Hajra Choudhury, and N. Roy, <i>Elements of Workshop Technology</i> , Vol. I, 9th ed. Mumbai: Media Promoters and Publishers, 2010. 2. S. K. Hajra Choudhury, A. K. Hajra Choudhury, and N. Roy, <i>Elements of Workshop Technology</i> , Vol. II, 15th ed. Calcutta: Indian Book Distributing Co., 2010.					

3. S. Kalpakjian and S. R. Schmid, *Manufacturing Engineering and Technology*, 9th ed. Harlow, U.K.: Pearson Education, 2026.
4. P. N. Rao, *Manufacturing Technology*, Vol. I, 5th ed. New Delhi: Tata McGraw-Hill, 2018.
5. H. S. Bawa, *Workshop Practice*, 2nd ed. New Delhi: Tata McGraw-Hill, 2009.
6. W. A. J. Chapman, *Workshop Technology*. New Delhi: CBS Publishers.

Sr. No	Manufacturing Practices and Fab Lab (MPFL) Practicals
01	Workshop Safety Demonstration and PPE Usage
02	Carpentry Tools Identification and Simple Wooden Joint Preparation
03	Fitting Tools Identification and Simple Fitting Job Preparation
04	Welding Tools Identification and Simple Arc / Gas Welding Joint Preparation
05	Machine Operations of all types of machines available in workshop
06	3D Printing, Rapid Prototyping & Laser Engraving



Robotics and Drone Operation and Safety					
Course Code	26U1VSEB011		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					
1. Understand basics of Robots, its elements, structure and classification 2. Select the sensors, drives, grippers for robots 3. Understand programming of Robot 4. Understand basics of drone, its classification and operations 5. Identify drone elements 6. Understand Drone Safety Guidelines and Regulations					
Unit 1: Basics of Robotics					06 Hrs
Basics of Robotics, Robot Laws, basic definitions, precision, accuracy, resolution & repeatability, Robot classification, Industrial robot’s specifications, Robot selection based on the Application. Components of Industrial robotics. Grippers, Classification of Grippers, Mechanical Gripper-Grasping force, mechanisms for actuation, Magnetic gripper vacuum cup gripper considerations in gripper selection & design. Controllers, Types of Controllers and introduction to close loop controller, Robot Sensors, Characteristics of sensing devices, Criterion for selections of sensors, Classification, & applications of sensors. Drives, Types of drives. Advantages and Disadvantages of each type, Selection /suitability of drives for Robotic application. Programming and Languages, Methods of robot programming, various languages Robot Applications: Material transfer and machine loading/unloading, processing operations assembly and inspection.					
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					
Textbooks / References:					
1. P. Corke, <i>Robotics, Vision, and Control: Fundamental Algorithms in MATLAB</i>, 2nd ed. Cham, Switzerland: Springer, 2020. 2. M. J. Mataric, <i>The Robotics Primer</i>. Cambridge, MA: MIT Press, 2007. 3. K. M. Lynch and F. C. Park, <i>Modern Robotics: Mechanics, Planning, and Control</i>. Cambridge, U.K.: Cambridge University Press, 2017. 4. D. Tal and J. Altschuld, <i>Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation</i>. Hoboken, NJ: John Wiley & Sons, 2021.					

5. J. Baichtal, *Building Your Own Drones: A Beginner's Guide to Drones, UAVs, and ROVs*. Indianapolis, IN: Que Publishing, 2016.
6. G. Završnik, *Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance*. Cham, Switzerland: Springer, 2018.
7. S. N. Mohanty, J. V. R. Ravindra, G. S. Narayana, C. R. Pattnaik, and Y. M. Sirajudeen, *Drone Technology: Future Trends and Practical Applications*, 2023.
8. I. V. S. Yeswanth and A. V. S. Sridhar Kumar, *Fundamentals of Drone Technology: Drones—The Future of 21st Century*, 2024.
9. T. Kilby and B. Kilby, *Make: Getting Started with Drones*. Sebastopol, CA: Maker Media.

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



Personality Development			
Course Code	26U1AEC002	Examination Scheme	
Teaching Scheme	0-0-2-2	CIE	100
Credit	1		
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

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Communication Skills			
Course Code	26U1AEC001	Examination Scheme	
Teaching Scheme	0-0-2-2	CIE	100
Credit	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 (<i>Para, Pashyanti, Madhyama, Vaikhari</i>) The Art of Dialogue: The principles of <i>Samvāda</i> (dialogue) from the Upanishads, emphasizing mutual respect, deep listening The Rasa Theory			
Suggested learning resources:			
1. S. Mishra & C. Muralikrishna, Communication Skills for Engineers, Droling Kindersley India Pvt. Limited Pearson, New Delhi, 02nd Edition. 2. N. Bhatnagar & M. Bhatnagar, Communicative English for Engineers, Droling Kindersley India Pvt. Limited Pearson, New Delhi, 03rd Edition. 3. N. Bhatnagar & M. Bhatnagar, Effective Communication and Soft Skills, Droling Kindersley India Pvt. Limited Pearson, New Delhi, 03rd Edition. 4. Sudarshana, N.P. and Savitha, C., English for Engineers, Cambridge University Press, 2nd Edition. 5. M. Ibbotson, Cambridge English for Engineering, Cambridge University Press, 2nd Edition.			

6. R. Murphy, Essential English Grammar (Elementary & Intermediate), Cambridge University Press India Pvt. Limited, 2nd Edition.
7. S. Tailor, Communication for Business: A Practical Approach, Pearson Longman, 2nd Edition
8. R. C. Sharma & Krishna Mohan, Business Correspondence and Report Writing, Tata McGraw Hill, 6th Edition



Fundamentals of Artificial Intelligence					
Course Code	26U1AICB001	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 learning 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]	S. Russell and P. Norvig, <i>Artificial Intelligence: A Modern Approach</i> , 4th ed. Pearson, 2020.				
[2]	P. Xiao, <i>Artificial Intelligence Programming with Python</i> , 1st ed. Wiley, 2022.				
Reference Books:					
[1]	D. L. Poole and A. K. Mackworth, <i>Artificial Intelligence: Foundations of Computational Agents</i> , 3rd ed. Cambridge University Press, 2023.				
[2]	R. S. Sutton and A. G. Barto, <i>Reinforcement Learning: An Introduction</i> , 2nd ed. A Bradford Book, 2018.				
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]	NPTEL 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]					

[7]	Papers with Code: A repository of academic papers with corresponding code implementations: https://paperswithcode.com/
[8]	TensorFlow Official Website: Excellent documentation and tutorials for the leading Deep learning framework: https://www.tensorflow.org/
[9]	PyTorch Official Website: Excellent documentation and tutorials for the leading deep learning framework: https://pytorch.org/
	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.

Fundamentals of Electrical Engineering					
Course Code	26UIEECB001	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:					
[1] D. C. Kulshreshtha, <i>Basic Electrical Engineering</i> , 2nd ed. New Delhi, India: McGraw Hill, 2019.					
[2] D. P. Kothari and I. J. Nagrath, <i>Basic Electrical Engineering</i> , 4th ed. New Delhi, India: Tata McGraw-Hill, 2019.					
[3] E. Hughes, <i>Electrical and Electronics Technology</i> , 10th ed. Harlow, U.K.: Pearson, 2010.					
[4] S. P. Seth, <i>A Course in Electrical Engineering Materials</i> . New Delhi, India: Dhanpat Rai Publications, 2011.					
Reference Books:					



[1] V. Del Toro, *Electrical Engineering Fundamentals*, 2nd ed. New Delhi, India: Prentice Hall India, 2015.

[2] L. S. Bobrow, *Fundamentals of Electrical Engineering*, 2nd ed. New York, NY, USA: Oxford University Press, 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	26U1ETCB001	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]	D. A. Bell, Electronic Devices and Circuits. New Delhi: Prentice Hall of India, 4th edition.				
[2]	J. Millman and C. C. Halkias, Electronic Devices and Circuits. New Delhi: Tata McGraw-Hill, 4th edition.				
[3]	R. P. Jain, Modern Digital Electronics. New Delhi: Tata McGraw-Hill, 4th edition.				
Reference Books:					
[1]	J. Millman and C. C. Halkias, Integrated Electronics. New Delhi: Tata McGraw-Hill, 2nd edition.				
[2]	R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory. New Delhi: Prentice Hall, 8th edition.				

[3]	B. G. Streetman and S. Banerjee, Solid State Electronic Devices. New Jersey: Prentice Hall, 6th edition.
[4]	M. M. Mano, Digital Design. Upper Saddle River, NJ: Pearson, 4th edition.

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	26U1ICCB001		Examination Scheme			
Teaching Scheme	2-0-2-1		MSE	30	CIE LAB	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:						
[1] H. Moore, <i>MATLAB for Engineers</i> . Pearson, 2023, 6th Edition.						
[2] A. Gilat, <i>MATLAB: An Introduction with Applications</i> . Wiley, 2023, 6th Edition.						
[3] R. Pratap, <i>Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers</i> . Oxford University Press, 1st/2nd Edition.						
[4] S. J. Chapman, <i>MATLAB Programming for Engineers</i> . Pearson, 2019, 6th Edition.						
Reference Books:						
[1] S. A. Away, <i>MATLAB: A Practical Introduction to Programming and Problem Solving</i> . Butterworth-Heinemann, 2023, 6th Edition.						
[2] Kwon and Bang, <i>The Finite Element Method Using MATLAB</i> . CRC Press.						
[3] D. Hanselman and B. Littlefield, <i>Mastering MATLAB</i> . Pearson.						
[4] S. N. Sivanandam and S. N. Deepa, <i>Introduction to MATLAB with Applications</i> . McGraw Hill.						
List of Experiments/Assignments:						

1. **Introduction to MATLAB Environment** – Familiarization with MATLAB interface, command window, workspace, and editor.
2. **Basic Operations** – Scalars, vectors, matrices, and array manipulations.
3. **Script and Function Files** – Writing user-defined functions and scripts.
4. **Control Structures** – Use of if, for, while, and switch statements with simple applications.
5. **Data Visualization (2D)** – Plotting line graphs, bar charts, pie charts, and multiple plots.
6. **3D Plots and Surface Visualization** – Mesh, contour, and surface plots.
7. **Numerical Methods** – Solving equations, interpolation, differentiation, integration.
8. **ODE Solvers** – Solving ordinary differential equations using ode45 and comparison with analytical results.
9. **Introduction to Simulink Environment** – Exploring blocks, libraries, and model creation.
10. **Basic Simulations** – Using sources, sinks, and mathematical blocks.
11. **Signal Routing and Visualization** – Use of Mux, Demux, Scope, and Display blocks.
12. **Modeling of Dynamic Systems** – Simulation of first order and second-order systems.
13. **Transfer Function and State-Space Models** – Implementing and analyzing responses in Simulink.
14. **Continuous and Discrete Systems** – Simulation using integrators and discrete blocks.



Essentials of Civil Engineering					
Course Code	26U1CECB001	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. S. P. Arora and S. P. Bindra, *A Textbook of Building Construction*, 5th ed. New Delhi: Dhanpat Rai Publications, 2025.
2. S. K. Duggal, *Surveying*, vol. I, 5th ed. New Delhi: Tata McGraw-Hill Education, 2019.
3. R. Singh, *Watershed Planning and Management*, 3rd ed. Jaipur, India: Yash Publishing House, 2016.
4. B. C. Punmia, A. K. Jain, and A. K. Jain, *Soil Mechanics and Foundations*, 19th ed. New Delhi: Laxmi Publications, 2026.
5. M. G. Shah, C. M. Kale, and S. Y. Patki, *Building Drawing with an Integrated Approach to Built Environment Drawing*, 5th ed. New Delhi: Tata McGraw-Hill Education, 2012.
6. K. A. Patil and I. K. Pateriya, *Basic Civil Engineering*. Aurangabad: Shree Laxmi Prakashan.
7. S. K. Garg, *Water Resources Engineering*, vol. I. New Delhi: Khanna Publishers.
8. S. K. Garg, *Water Resources Engineering*, vol. II. New Delhi: Khanna Publishers.
9. B. C. Punmia, A. K. Jain, and A. K. Jain, *Water Supply Engineering*, 2nd ed. New Delhi: Laxmi Publications Pvt. Ltd., 2022.
10. B. C. Punmia, A. K. Jain, and A. K. Jain, *Waste Water Engineering Including Air Pollution*. New Delhi: Laxmi Publications.

Reference Books:

- [1] E. M. Tideman, *Watershed Management: Guidelines for Indian Conditions*. New Delhi: Omega Scientific Publishers, 1996.
- [2] S. Kumar, *Building Construction*, 20th ed. New Delhi: Standard Publishers Distributors, 2026.

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

Systems in Mechanical Engineering					
Course Code	26U1MECB001	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.					
Textbooks:					
Rajput, R.K., Basic Mechanical Engineering, Laxmi Publications Pvt. Ltd, 2010					
Reference Books:					

- [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] Yunus A. Cengel & Boles, Thermodynamics, Tata McGraw-Hill Publisher Co. Ltd., 2001
- [4] Arora and Domkunwar, Thermal Engineering, Dhanpat Rai and Sons., 2009
- [5] Rayner Joel, Basic Engineering *Thermodynamics*, Pearson Education, 2008
- [6] V. B Bhandari, Design of machine elements, Tata McGraw-Hill Publisher Co. Ltd., 2010
- [7] V. Ganeshan, Internal Combustion Engines, McGraw Hill Publisher Co. Ltd., 2018



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.	



Structure and Properties of Materials (Theory)					
Course Code	26U1MMCB001	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. 5th ed. New Delhi, India: Prentice Hall of India, 2006. • W. D. Callister, Materials Science and Engineering: An Introduction, 8th ed. Hoboken, NJ, USA: John Wiley & Sons, 2006.					
Reference Books:					
• W. F. Smith, <i>Foundations of Materials Science and Engineering</i>, 5th ed. New York, NY, USA: McGraw-Hill, 2009. • Schroder, <i>Electronic, Magnetic, and Thermal Properties of Solids</i>, 1st ed. New York, NY, USA: Marcel Dekker, 1978.					

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.



Fundamentals of Production Drawing (FPD)

Course Code	26U1MFCB001	Scheme of Evaluation	Theory	Lab CIE
Teaching Plan	2-0-2-1	CIE	20	100
Credits	3	MSE	30	
Practical Plan	2 hrs/ week	ESE	50	

Course Outcomes (COs):

CO1	Explain the fundamentals of production drawing, BIS standards, drawing conventions, dimensioning practices, scales, and sheet layouts used in manufacturing drawings.
CO2	Construct and interpret orthographic projections, Multiview drawings, and isometric views of engineering objects.
CO3	Apply the concepts of limits, fits, tolerances, tolerance grades, and basic GD&T in production drawings for manufacturing applications.
CO4	Interpret and represent machining symbols, surface roughness symbols, and welding symbols while preparing production drawings as per ISO/BIS standards.

Syllabus:

Unit	Contents	Lectures (hrs.)
1.	Fundamentals: Importance of production drawing in manufacturing, Difference between engineering drawing and production drawing, Types of production drawings, BIS standards and conventions Drawing Practices: Types of lines and lettering, Dimensioning principles, Title block and sheet sizes and layout, Concept of scales, Representative Fraction (RF),	4
2.	Multiview Orthographic Projections: Types of projection, First and Third angle projections, orthographic projections of points, lines, plane on principle planes, Multiview representation of simple objects	6
3.	Isometric Views and Projections: Isometric scale, Isometric view of planes and simple solids, Development of surfaces, Introduction to CAD tool	6
4.	Limits, Fits and Tolerances: Basic terminology, Types of fits, Hole basis and shaft basis systems, Types of Tolerance, Tolerance grades, Introduction to GD&T	4
5.	Surface Representation: Machining Symbols, types of surface roughness, Lay symbols, ISO Surface Roughness symbol, Welding Representation: Basic and supplementary weld symbols, Representation of welded joints, ISO welding symbol structure	4

Suggested learning resources:

1. K. L. Narayana, P. Kannaiah, and K. Venkata Reddy, *Production Drawing*. New Delhi: New Age International, 2011.
2. N. D. Bhatt and V. M. Panchal, *Engineering Drawing*, 50th ed. Anand, India: Charotar Publishing House, 2010.

3. K. L. Narayana, P. Kannaiah, and K. Venkata Reddy, *Machine Drawing*. New Delhi: New Age International, 2009.
4. S. Singh and P. L. Sah, *Fundamentals of Machine Drawing*, 2nd ed. New Delhi: PHI Learning, 2012.
5. Bureau of Indian Standards, *SP 46:2003: Engineering Drawing Practice for Schools and Colleges*. New Delhi: Bureau of Indian Standards, 2003.

Introduction to Production Drawing (IPD) Laboratory

01	Lettering, Types of Lines, Dimensioning, Scales
02	Multiview Orthogonal Projections Points, Lines and 3D objects
03	Orthographic to Isometric Views
04	Development of surfaces
05	Limits Fits and Tolerance, GD&T symbols, Feature Control Frame
06	Surface representation and Machining Symbols
07	Weld symbols, Weld joints representation, ISO Welding symbol
08	Drafting using CAD tools



Discrete Structures					
Course Code:	26U1CSCB002	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]	K. H. Rosen, <i>Discrete Mathematics and Its Applications</i> , 7th ed. Tata McGraw-Hill, 2017.				
[2]	C. L. Liu, <i>Elements of Discrete Mathematics</i> , 4th ed. Tata McGraw-Hill, 2017.				
Reference Books:					
[1]	G. Shanker Rao, <i>Discrete Mathematical Structures</i> , 2nd ed. New Age International, 2009.				
[2]	S. Lipschutz and L. Lipson, <i>Discrete Mathematics</i> , 2nd ed. Tata McGraw-Hill, 1999.				
[3]	K. Balakrishnan, <i>Graph Theory</i> , 1st ed. Tata McGraw-Hill, 2004.				

[4]	B. Kolman, R. Busby, and S. Ross, <i>Discrete Mathematical Structures</i> , 4th ed. Pearson Education, 2002.
[5]	J. Tremblay and R. Manohar, <i>Discrete Mathematical Structures with Applications to Computer Science</i> . Tata McGraw-Hill, 2002.
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.



Electrical and Electronic Measurements and Instrumentation						
Course Code	26UIEECB002		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 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, synchrosopes, 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 diaphragm. 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.
- John 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 oscilloscope 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	26U1ETCB002	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 fundamentals of electronic systems, op-amps, and network functions. (BL2) 1. Analyze circuits using network functions and frequency response concepts. (BL4) 2. Design analog filters for signal conditioning in real-world systems. (BL3) 3. Integrate sensors with conditioning circuits for practical applications. (BL3) 4. Apply control system principles using feedback and stability analysis. (BL3) 5. 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] A. S. Sedra and K. C. Smith, Microelectronic Circuits, 8th ed. Oxford, UK: Oxford Univ. Press, 2020.
- [2] M. E. Van Valkenburg, Network Analysis, 3rd ed. Delhi, India: Pearson Education, 2015.
- [3] K. Ogata, Modern Control Engineering, 5th ed. Upper Saddle River, NJ, USA: Prentice Hall, 2010.

Reference Books:

- T. S. Rappaport, Wireless Communications: Principles and Practice, 2nd ed. Upper Saddle River, NJ, USA: Pearson, 2010.
- D. V. Hall, Microelectronics and VLSI Design, 2nd ed. New York, NY, USA: McGraw-Hill, 2011.
- J. G. Webster, Medical Instrumentation: Application and Design, 4th ed. Hoboken, NJ, USA: Wiley, 2009.
- R. Kamal, Internet of Things: Architecture and Applications, 2nd ed. New York, NY, USA: McGraw-Hill, 2021.
- S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 4th ed. Upper Saddle River, NJ, USA: Pearson, 2020.
- IEEE Spectrum, IEEE Commun. Mag., and IEEE Internet Things J., recent issues.



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)
6.	Implement op-amp and filter circuits for signal processing. (BL3)
7.	Characterize sensors and demonstrate their use in signal conditioning. (BL3)
8.	Differentiate between open-loop and closed-loop control using experiments. (BL2)
9.	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	26U1ICCB002	Examination Scheme			
Teaching Scheme	2-0-2-1	MSE	30	CIE LAB	100
Credits	3	CIE	20		
		ESE	50		
Course Outcomes: At the end of the course, students will demonstrate the ability to					
1. List of 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 and Bridges:					7 Hrs
Concepts and terminology of measurement system, transducer, sensor, classification of transducers, static and dynamic characteristics, selection criteria. Bridges: Wheatstone bridge, Maxwell's bridge, Schering bridge: design and application.					
Unit 2: Displacement, Velocity and Acceleration Measurement:					8 Hrs
Displacement Measurement: Linear and rotary type Potentiometer, LVDT, Hall Effect. Velocity Measurement: Moving magnet and moving coil type. Acceleration Measurement: Potentiometric, LVDT, Piezo-electric					
Unit 3: Force and Torque measurement:					7 Hrs
Force Measurement: Elastic force traducers, strain gauge, Load cells, Torque Measurement: Inductive torque meter, Magneto- strictive transducers, torsion bar dynamometer					
Unit 4: Basic Measuring Instruments:					8 Hrs
Oscilloscope: Introduction, various parts, and front panel controls. Use of CRO for measurement of voltage, current, period, and frequency. Introduction to Digital Storage Oscilloscope (DSO) and Digital Multimeter (DMM).					
Textbooks:					
[1] A. K. Sawhney, Electrical and Electronic Measurements and Instrumentation. New Delhi: Dhanpat Rai and Sons, 2005, 12th Edition. [2] B. C. Nakra and K. K. Choudhary, Instrumentation, Measurements and Analysis. New Delhi: Tata McGraw Hill Education, 2016, 4th Edition.					
Reference Books:					
[1] E. O. Doebelin, Measurement Systems. New Delhi: McGraw Hill, 2017, 6th Edition. [2] D. Patranabis, Principles of Industrial Instrumentation. New Delhi: Tata McGraw Hill, 1999, 2nd Edition. [3] A. J. Bouwens, Digital Instrumentation. New Delhi: Tata McGraw Hill, 2008, 6th Reprint. [4] H. S. Kalsi, Electronic Instrumentation. New Delhi: Tata McGraw Hill, 2017, 4th Edition. [5] A. D. Helfrick and W. D. Cooper, Modern Electronic Instrumentation and Measurement Techniques. New Delhi: Prentice Hall of India, 1990, 2nd Edition					

List of Experiments:

1. Resistance measurement using Wheatstone bridge
2. Inductance measurement using Maxwell's bridge
3. Capacitance measurement using Schering bridge
4. Characterization LVDT based displacement measurement system.
5. Characterization Hall Effect based displacement measurement system.
6. Characterization and calibration of potentiometer as displacement sensor. Study of loading effect on potentiometer (linear and rotary).
7. Characterization of strain gauge using cantilever beam
8. Characterization and calibration of piezoelectric measurement system.
9. Measurement using proximity sensors (inductive/Capacitive) for an application



Engineering Mechanics					
Course Code	26U1CECB002	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 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] R. C. Hibbeler, <i>Engineering Mechanics: Statics</i> , 14th Edition, Pearson, 2019.					
[2] R. C. Hibbeler, <i>Engineering Mechanics: Dynamics</i> , 14th Edition, Pearson, 2019.					
[3] F. P. Beer, E. R. Johnston, D. Mazurek, P. J. Cornwell, and B. Self, <i>Vector Mechanics for Engineers: Statics and Dynamics</i> , 12th Edition, McGraw-Hill Education, 2019.					
Reference Books:					

- [1] J. L. Meriam, L. G. Kraige, and J. N. Bolton, *Engineering Mechanics: Statics*, 8th Edition, Wiley, 2014.
- [2] J. L. Meriam, L. G. Kraige, and J. N. Bolton, *Engineering Mechanics: Dynamics*, 8th Edition, Wiley, 2015.
- [3] A. Bedford and W. Fowler, *Engineering Mechanics: Statics and Dynamics*, 6th Edition, Pearson, 2023.

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	26U1MECB002	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.					
5. Draw 2D and 3D drawings using computer aided drafting tool.					
6. Draw Machine elements and their conventional representation.					
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, Engineering Drawing, Charotar Publishing House ,2011.				
2.	M.L.Dabhade , Engineering Graphics I and II , Vision Publications,2004				
Reference Books:					
1.	Warren Luzzader, Jon M. Duff, Fundamentals of Engineering Drawing, Pearson Education,2008				
2.	M.B.Shah , B.C.Rana , Engineering Drawing, Pearson Education ,2008				
3.	Dhananjay A. Jolhe, Engineering Drawing with an introduction to AutoCAD, Tata McGraw Hill Publishing Company Limited, 2008.				

4.	R.B. Gupta, Machine Drawing, Satya Prakashan, New Delhi, 2010
Education Agrawal B. & Agrawal C. M. , “Engineering Graphics”, Tata McGraw Publication Suraj Singh , “ Civil Engineering Building Practice ”	



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)



Fuels, Furnaces and Refractories (Theory)					
Course Code	26U1MMCB002	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:					
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]

- R. C. Gupta, Fuels, Furnaces and Refractories, 1st ed. Delhi, India: PHI Learning Pvt. Ltd., 2016.
- V. K. Suryanarayana, Fuels, Furnaces, Refractories and Pyrometry, 2nd ed. India: B. S. Publications, 2015.
- O. P. Gupta, Elements of Fuels, Furnaces & Refractories, 6th ed. New Delhi, India: Khanna Publishers, 2014.
- O. P. Gupta, Elements of Refractory Technology, 1st ed. New Delhi, India: Khanna Book Publishing Co. Ltd., 2017.
- W. Trinks, M. H. Mawhinney, R. A. Shannon, R. J. Reed, and J. R. Garvey, Industrial Furnaces, 6th ed. Hoboken, NJ, USA: John Wiley & Sons, 2003.
- D. Gilchrist, Fuels, Furnaces and Refractories. Oxford, U.K.: Pergamon Press, 1977.

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.

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 method 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-Martens, 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	26U1MFCB002	Scheme of Evaluation			
Teaching Scheme	2-0-2-1	CIE	20	CIE	100
Credits	3	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. M. P. Groover, *Automation, Production Systems, and Computer-Integrated Manufacturing*, 5th ed. Pearson, 2021.
2. M. Soroush, M. Baldea, and T. F. Edgar, *Smart Manufacturing: Concepts and Methods*. Amsterdam, The Netherlands: Elsevier, 2020.
3. A. Gilchrist, *Industry 4.0: The Industrial Internet of Things*, 1st ed. Berkeley, CA: Apress, 2016.
4. NPTEL, *Online Courses and Learning Materials on Manufacturing and Industry 4.0*.

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	26U1IKCL001	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.			

