COEP Technological University Pune
(A Unitary Public University of Govt. of Maharashtra)

School of Engineering and Technology
Curriculum Structure and Detailed Syllabus

S.Y. B. Tech.
Electrical Engineering

(Effective from: A.Y. 2026-27)
Curriculum and Structure of S.Y. B. Tech. in
Electrical Engineering

Program Educational Objectives (PEOs)

After the completion of the program

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

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

III. Student will demonstrate effective communication, life long learning ability, integrity, team work, leadership qualities, concern to environment and commitment tosafety, 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 dataand synthesis of the information to provide valid conclusion.

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

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

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

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

PO9: Individual and Team Work: Function effectively as an individual, and as themember or leader n diverse team and multidisciplinary setting.

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

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

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

Program Specific Outcome for Undergraduate (PSOs):

PSO13: To design and develop power electronics hardware and its control to cater the needsof industry such as electric vehicles, renewable interconnections, smart grid and micro-grid.

PSO14: To analyze and solve the problems related to smart grid using modern techniquesand tools.

PSO15: To design, simulate, and make prototype of special purpose machines for enhancing the Performance.

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)

S. Y. B. Tech. Electrical Engineering
[Level 5, UG Diploma] Regular Students Semester -III

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
01	PCC	<*tbd*>	Signals and Systems	2	1	0	1	3	30	10	60	--	--
02	PCC	<*tbd*>	Electric Circuit Analysis	2	0	2	1	3	30	20	50	50	50
03	PCC	<*tbd*>	Analog and Digital Electronics	3	0	2	1	4	30	10	60	50	50
04	PCC	<*tbd*>	Numerical Methods and Computer Programming	1	0	2	1	2	CIE:100			50	50
05	OE	<*tbd*>	Open Elective - I	2	0	0	1	2	30	20	50	--	--
06	VEC	<*tbd*>	Environmental Studies	1	0	0	2	1	CIE: 100			--	--
07	CEA	<*tbd*>	Community Engagement Activity (CEA)/Field Project	-	-	4	-	2	--	--	--	CIE: 100	
08	HSMC	<*tbd*>	Design Thinking	-	-	2	1	1	--	--	--	CIE: 100	
09	HSMC	<*tbd*>	Professional Economics	2	0	0	0	2	30	20	50	--	
			Total	**13**	**01**	**12**	**08**	**20**					

[Level 5, UG Diploma] Semester -IV

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
01	PCC	<*tbd*>	Microcontrollers and Applications	2	0	2	1	3	30	10	60	50	50
02	PCC	<*tbd*>	Electromagnetic Fields	2	0	0	1	2	30	20	50	--	--
03	PCC	<*tbd*>	Electrical Machines	3	0	2	1	4	30	10	60	50	50
04	VEC-2	<*tbd*>	Constitution of India	1	0	0	2	1	CIE: 100			--	--
05	OE	<*tbd*>	Open Elective - II	2	0	0	1	2	30	20	50	--	--
06	VSEC	<*tbd*>	Electrical Wiring Design and Estimation Lab	1	0	2	0	2	30	20	50	--	--
07	MDM	<*tbd*>	Multidisciplinary Minor – I	3	0	2	1	3	30	20	50	--	--
08	HSMC	<*tbd*>	Indian language	2	0	0	1	2	CIE: 100				
09	HSMC	<*tbd*>	Entrepreneurship	1	0	0	1	1	30			20	50
			Total	**17**	**00**	**08**	**09**	**20**					

Legends: **L**-Lecture, **T**-Tutorial, **P**-Practical, **S**-Self Study, **Cr**-Credits
ISE-In-Semester-Evaluation, **ESE**-End-Semester-Evaluation, **MSE**-Mid-Semester-Evaluation, **TA**-Teachers' Assessment, **CIE**-Continuous-Internal-Evaluation

Exit option to qualify for UG Diploma:

- Electrical Installation, Estimation and Costing (3 Credits)
- PLC for Industrial Automation (3 Credits)

S. Y. B. Tech. Electrical Engineering

[Level 5, UG Diploma] Lateral Entry Students- Semester -III

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
01	PCC	<*tbd*>	Signals and Systems	2	1	0	1	3	30	10	60	--	--
02	PCC	<*tbd*>	Electric Circuit Analysis	2	0	2	1	3	30	20	50	50	50
03	PCC	<*tbd*>	Analog and Digital Electronics	3	0	2	1	4	30	10	60	50	50
04	PCC	<*tbd*>	Numerical Methods and Computer Programming	1	0	2	1	2	CIE:100			50	50
05	BS-06	<*tbd*>	Matrices, Differential Calculus and Probability	3	0	0	1	3	30	10	60	---	---
06	OE	<*tbd*>	Open Elective - I	2	0	0	1	2	30	20	50	--	--
07	VEC	<*tbd*>	Environmental Studies	1	0	0	2	1	CIE: 100			--	--
08	HSMC	<*tbd*>	Design Thinking	-	-	2	1	1	--	--	--	CIE: 100	
09	HSMC	<*tbd*>	Professional Economics	2	0	0	0	2	30	20	50	--	
Total				**16**	**01**	**08**	**09**	**21**					

[Level 5, UG Diploma] Lateral Entry Students Semester -IV

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
01	PCC	<*tbd*>	Microcontrollers and Applications	2	0	2	1	3	30	10	60	50	50
02	PCC	<*tbd*>	Electromagnetic Fields	2	0	0	1	2	30	20	50	--	--
03	PCC	<*tbd*>	Electrical Machines	3	0	2	1	4	30	10	60	50	50
04	VEC-2	<*tbd*>	Constitution of India	1	0	0	2	1	CIE: 100			--	--
05	OE	<*tbd*>	Open Elective - II	2	0	0	1	2	30	20	50	--	--
06	VSEC	<*tbd*>	Electrical Wiring and Estimation Lab	2	0	0	0	2	30	20	50	--	--
07	MDM	<*tbd*>	Multidisciplinary Minor – I	3	0	0	1	3	30	20	50	--	--
08	HSMC	<*tbd*>	Communication Skills	1	0	2	0	2	CIE:100			CIE:100	
09	HSMC	<*tbd*>	Indian language	2	0	0	1	2	CIE: 100				
10	HSMC	<*tbd*>	Entrepreneurship	1	0	0	1	1	30			20	50
Total				**19**	**00**	**06**	**09**	**22**					

Legends: **L**-Lecture, **T**-Tutorial, **P**-Practical, **S**-Self Study, **Cr**-Credits
ISE-In-Semester-Evaluation, **ESE**-End-Semester-Evaluation, **MSE**-Mid-Semester-Evaluation, **TA**-Teachers' Assessment, **CIE**-Continuous-Internal-Evaluation

Open Electives offererd by Electrical Engineering Department

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
01	OE-I	<*tbd*>	Electrical Installation and Practices	2	0	0	1	2	30	20	50	--	--
02	OE-II	<*tbd*>	Power Electronics and Machine Drives	2	0	0	1	2	30	20	50	--	--
03	OE-III	<*tbd*>	Electric Vehicle Technology	2	0	0	1	2	30	20	50	--	--
			Total	**6**	**0**	**0**	**3**	**6**					

Additional Credits for Exits
After Completion of Second Year

Sr. No.	Course Code	Course Title	L	T	P	Cr	Category
01	VSEC-02	Electrical Design Softwares	1	0	4	3	VSEC
02	VSEC-03	PLC for Industrial Automation	1	0	4	3	VSEC
		Total	**02**	**00**	**08**	**06**	

SEMESTER III

Signals and System						
Course Code	**(EE 24001)**		**Examination Scheme**			
Teaching Scheme	2-1-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	3		**Laboratory**	CIE: 00	ESE: 00	--
Course Outcomes: Students will be able to:						
At the end of the course, students will be able to 1. Classify and mathematically represent continuous-time and discrete-time signals and systems. 2. Analyze continuous-time and discrete-time LTI systems using differential/difference equations, impulse response, and convolution. 3. Apply Fourier analysis techniques to determine spectral characteristics of signals and interpret sampling and aliasing phenomena. 4. Analyze discrete-time systems using Z-transform techniques, pole-zero representations, and stability criteria. 5. Evaluate and interpret time-frequency representations and localized signal parameters for non-stationary signals..						
Unit1: Fundamentals of Signals and Data Representations						**[5 Hrs]**
Definition and mathematical representation of continuous-time (CT) and discrete-time (DT) signals and systems. Classification of signals: deterministic/random, periodic/aperiodic, energy/power, analog/digital, causal/noncausal. Elementary Signal Space: Unit impulse, unit step, unit ramp, exponential, sinusoidal, and complex exponential signals. Signal Operators: Amplitude scaling, addition, multiplication, time shifting, time folding, time scaling. Basic principles of sampling and interpolation, Representation of signals as vectors and functional signal spaces.						
Unit 2: Linear Time-Invariant Systems and Convolution						**[5 Hrs]**
System Properties: linearity, time invariance, causality, stability, invertibility, and memory. Time-Domain Characterization: Continuous-time and discrete-time Linear Time-Invariant (LTI) systems, impulse response characterization, Characterization of systems using linear constant-coefficient differential and difference equations, convolution integral for CT-LTI systems and convolution sum for DT-LTI systems, interconnection of LTI systems. Computational interpretation of convolution in signal processing and its direct structural relation to localized feature extraction operations in Convolutional Neural Networks (CNNs).						
Unit 3: Fourier Analysis and Frequency Domain Representation						**[6 Hrs]**
Fourier Series: Fourier series representation of periodic signals using trigonometric and exponential Fourier series. Continuous and Discrete Fourier Transforms: Continuous-Time Fourier Transform (CTFT) and Discrete-Time Fourier Transform (DTFT), magnitude and phase spectrum. Properties of Fourier transforms: linearity, time shifting, frequency shifting, convolution theorem, and Parseval's relation. System Frequency Response: Frequency response of LTI systems. Sampling Phenomena: The Nyquist-Shannon sampling theorem; mathematical and visual mechanics of spectral overlap (aliasing); anti-aliasing filtering.						
Unit 4: Discrete Fourier Analysis and Laplace-Transform						**[6 Hrs]**

Discrete Fourier Analysis: Introduction to the Discrete Fourier Transform (DFT) and its structural properties. Introduction to Fast Fourier Transform (FFT): Conceptual overview of Radix-2 decimation-in-time concepts.

Laplace-Domain Analysis: Definition of the Laplace Transform, Region of Convergence (ROC), significance and geometric interpretation of ROC. Properties of the Laplace Transform including linearity, time shifting, frequency shifting, differentiation and integration. Inverse Laplace Transform using standard transform pairs and partial fraction expansion. Transfer function representation, pole-zero plots, stability analysis, causality, and BIBO stability interpretation. Relationship between the Fourier Transform and the Laplace Transform.

Unit 5: Mixed Time-Frequency Analysis & Multiresolution Foundations	**[6 Hrs]**

Time-Frequency Localized Analysis: Fundamental limitations of global Fourier transformations for non-stationary analyses. Short-Time Fourier Transform (STFT) mathematical mechanics and 2D spectrogram matrix representations. Resolution Bounds: The window length resolution trade-off and the underlying Heisenberg uncertainty principle in joint time-frequency grids. Multiresolution Analysis: Introduction to time-frequency localized analysis and wavelet transforms.

Textbooks:

[1]	Alan V. Oppenheim, Alan S. Willsky, and S. Hamid Nawab, "Signals and Systems", Pearson Education, 2nd Edition, 2014.
[2]	B. P. Lathi and Roger Green, "Linear Systems and Signals", Oxford University Press, 3rd Edition, 2018.
[3]	Simon Haykin and Barry Van Veen, "Signals and Systems", Wiley India, Revised and Updated International Adaptation, 2026.
[4]	Alan V. Oppenheim and George C. Verghese, "Signals, Systems and Inference", Pearson Education, 1st Edition, Reprint 2026.
[5]	Luis F. Chaparro and Aydin Akan, "Signals and Systems using MATLAB", Academic Press.

Reference Books:

[1]	Alan V. Oppenheim and Ronald W. Schafer, "Discrete-Time Signal Processing", Pearson Education, 3rd Edition, 2010
[2]	John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing", Pearson Education, 4th Edition, 2007.
[3]	B. P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, 2nd Edition.
[4]	Tarun Kumar Rawat, "Signals and Systems", Oxford University Press, 1st Edition, 2010.
[5]	Michael J. Robert, “Introduction to Signals and Systems”, TMH, Second ed., 2003

e - learning resource

International Resources · MIT OpenCourseWare (Prof. Alan V. Oppenheim): Signals and Systems. MIT 6.003 / RES.6-007. · MIT OpenCourseWare: Signals, Systems and Inference. MIT 6.011.

Stanford Engineering Everywhere (SEE): The Fourier Transform and its Applications. Stanford EE261. Indian Resources

NPTEL: Signals and Systems by IIT Kharagpur.

NPTEL: Digital Signal Processing by IIT Madras.

https://onlinecourses.nptel.ac.in/noc21_ee28/preview,Signals and Systems, By Prof. Kushal K. Shah,IISER Bhopal

Electric Circuit Analysis

Course Code	[EE-24002]		Examination Scheme			
Teaching Scheme	2-1-2-1		Theory	TA: 20	MSE: 30	ESE: 50
Credits	3		Laboratory	CIE: 50	ESE: 50	--

Course Outcomes:

At the end of this laboratory course the students will demonstrate the ability to:

1.Compute parameters of a given two port network.

2.Use MATLAB, Scilab, PSIM, and ATP/EMTP for circuit development and analysis

3.Validate the circuit theorems experimentally

Unit 1 :Network Topology: **(5 Hrs)**

Kirchhoff's laws to network analysis, choice between loop and nodal analysis. Concept of super loop and super mesh, dot convention for coupled circuits. Concept of duality and dual networks. Concept of graph, tree and co-tree, tie set and cut set matrices.

Unit 2 **(5 Hrs)**

Analysis of Transients in the circuit:

Initial and final conditions in network elements. Forced and free response, time constants steady state and transient state response. Classical solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits.

Unit 3 **(5 Hrs)**

Network Functions for one port and two ports:

Calculations of network functions for ladder and general network. Poles and zeros, restrictions on pole and zero locations for driving point and transfer functions.Time domain behavior from pole and zero plot. Stability of active network.

Two Port Network: Terminal pairs, relationship of two port variables - Z, Y, transmission parameters and hybrid parameters, interconnections of two port networks.

Unit 4 **(5 Hrs)**

Application of the Laplace Transformation:

Review of Laplace transform, inverse Laplace transform. Analysis of electrical circuits with and without initial conditions using Laplace transform for all standard input cases. Shifted and singularity functions, Laplace transform of various periodic and non-periodic waveforms.

Unit 5 **(5 Hrs)**

Sinusoidal steady state analysis of single phase and three phase circuits:

Power transfer and insertion loss of two port network. Effective or RMS values, average power and complex power. Problems in optimizing power transfer in electrical network.

Balanced and unbalanced load in three phase circuits.

Text Books:

- Alexander and Sadiku, "Electric Circuits", 5th edition, 2012. TMH
- M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 3rd edition
- D. Roy Chaudhary, "Network and Systems", New Age International Publications, 2nd edition.

Reference Book:

- William H. Hayt, Jack E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill international , 5th edition corrections), Jaico Publishing, 1998.

e Learning Resource:

NPTEL Video lectures BY Ankush Sharma IIT Kanpur and by Dr. S. C. Datta Roy IIT Delhi.

Analog and Digital Electronics						
Course Code	**EE 24003**		**Examination Scheme**			
Teaching Scheme	3-1-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	4		**Laboratory**	CIE: 50	ESE: 50	--

Course Outcomes: Students will be able to:

1. Understand and analyze the characteristics and performance of semiconductor devices, analog circuits, and operational amplifier-based systems.
2. Design and implement electronic circuits using op-amp and special purpose ICs.
3. Analyze and construct combinational and sequential digital logic circuits.
4. Analyze Analog-to-Digital (ADC) and Digital-to-Analog (DAC) conversion systems.
5. Understand programmable digital systems using HDL and FPGA architectures.

Semiconductor Devices: **[8 Hrs]**

Introduction to semiconductor devices; BJT characteristics in CB, CE, and CC configurations; transistor biasing techniques; transistor as a switch; DC and small-signal analysis of BJT amplifier CE configuration; frequency response analysis (No derivation)

MOSFET construction, operating principles, and DC analysis, MOSFET as a switch, small-signal analysis of MOSFET amplifier in CS configuration; frequency response analysis (No derivation)

Operational Amplifiers and its applications **[9 Hrs]**

Difference amplifier, current mirror circuit, block diagram of operational amplifier, AC and DC characteristics of ideal and practical op-amp, equivalent circuit of Op-Amp, open-loop configurations, feedback configurations and block diagram representation and its effect on performance of an amplifier

Comparators and oscillators; DC and AC amplifiers; instrumentation amplifiers; logarithmic amplifiers; voltage-to-current and current-to-voltage converters; integrators and differentiators.

Active filters: low-pass, high-pass, band-pass, band-reject, and all-pass filters.

Special Purpose ICs: **9 Hrs]**

555 Timer in monostable and astable multivibrator configurations; Phase Locked Loop (PLL) operating principles; applications of IC 565 PLL; voltage regulators including fixed, adjustable, switching, and special regulators; analog switches and analog multipliers.

Digital-to-Analog Converters:

Weighted resistor DAC, R-2R ladder DAC, specifications, and DAC IC examples**.**

Analog-to-Digital Converters

Sample-and-hold circuits; quantization and encoding techniques; flash (parallel comparator) ADC, successive approximation ADC, dual-slope ADC, voltage-to-frequency and voltage-to-time conversion ADCs; specifications of ADCs.

Logic Families and Digital Circuits: **[9 Hrs]**

Introduction to digital logic families.

Combinational Digital Circuits

Adders, subtractors, digital comparators, parity generators/checkers, code converters, multiplexers, demultiplexers, priority encoders, and decoders. **Sequential Digital Circuits** Shift registers and their applications; serial-to-parallel and parallel-to-serial converters; ring counters; sequence generators; asynchronous and synchronous counters; counter design using flip-flops; special counter ICs; asynchronous sequential counters and applications of counters.
Programmable Logic, and Emerging Hardware Systems **[7 Hrs]**
RAM and ROM concepts and classifications**.** Programmable Logic Devices (PLDs) and FPGA architectures; Introduction to Verilog/VHDL; HDL-based implementation of combinational and sequential circuits.

Self-Study (SS):	**[6 Hrs]**
1. CMOS technology trends 2. FinFET and Nano transistor basics 3. SPICE simulation of circuits using LTspice 4. Role of FPGA based hardware accelerators in AI systems Edge AI, and TinyML hardware concepts. 5. Introduction to in-memory computing, memristors, neuromorphic hardware,	
Textbooks:	
[1]	S. Sedra, K. C. Smith, Tony Chan Carusone, and Vincent Gaudet, *Microelectronic Circuits*, 8th Edition, Oxford University Press, 2020.
[2]	Jacob Millman, Christos C. Halkias, and Satyabrata Jit, *Electronic Devices and Circuits*, 4th Edition, McGraw Hill Education, 2015.
[3]	Robert L. Boylestad and Brian A. Olivari, *Electronic Devices and Circuit Theory*, 14th Edition, Pearson Education, 2022
[4]	Ramakant A. Gayakwad, *Op-Amps and Linear Integrated Circuits*, 5th Edition, Pearson Education, 2017
[5]	R. P. Jain and Kishor Sarawadekar, *Modern Digital Electronics*, 5th Edition, McGraw Hill Education, 2022.
[6]	Anand Kumar, *Fundamentals of Digital Circuits*, 5th Edition, PHI Learning, 2022.
[7]	J. Bhasker, *A VHDL Primer*, 3rd Edition, Pearson Education, 2015. Pearson Education Link
Reference Books:	
[1]	Thomas L. Floyed, "Electronic Devices", 10th edition, Pearson Education, 2018.
[2]	James M. Fiore, "Op Amps and Linear Integrated Circuits-Concepts and Applications", 3rd edition, Cengage Learning, 2018
[3]	David A. Bell, "Electronic Devices and Circuits", 5th edition, Oxford University Press, 2008
[4]	Herbert Taub, Donald Schilling, "Digital Integrated Electronics", 1st edition, Tata McGraw Hill, 2017
[5]	Donald Leech, Albert Malvino, Goutam Saha," Digital Principles and Applications", 8th edition, McGraw Hill Education, 2014

Note:	
[1] [2] [3] [4] [5]	To measure CO1, questions may be of the type- define, identify, state, match, list, name etc. To measure CO2, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc. To measure CO3, questions will be based on applications of core concepts. 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. To measure CO5, some questions may be based on self-study topics and comprehension of unseen passages.
	Analog and Digital Electronics Laboratory
	Course Outcomes: At the end of this course students will demonstrate the ability to, 1. Evaluate the performance characteristics of different semiconductor devices. 2. Build and evaluate the performance of a wide variety of analog circuits using operational amplifier. 3. Use software packages like Proteus, Multisim, PSpice etc. 4. Apply the knowledge for implementation of different circuits using analog ICs. 5. Construct combinational and sequential circuits. 6. Understand the operation of various ADC/DAC.
	List of Experiments: **Analog Electronics** The laboratory course can have any 5 experiments from following list. At least 1 experiment should involve simulation using Proteus or appropriate software. 1. To design, assemble and test the wave shaping circuits using diode - clipping and clamping circuits. 2. To determine the performance characteristics of BJT using DC biasing analysis of CE, CB and CC Configuration. 3. To determine the frequency Response of a BJT/FET single stage and multistage amplifier and to study the effect of coupling and bypass capacitor on the frequency. 4. To obtain the drain and transfer characteristics of JFET. 5. Analysis and applications of active circuits using Op-Amp: (i) Comparator (ii) Zero Crossing Detector, (iii) Integrator, (iv) Logarithmic amplifier, (v) Differentiator. 6. To design, assemble and test the active filters and oscillators using Op-Amp and determine their frequency stability: (i) Low pass, (ii) High pass, (iii) Band pass, (iv) Band reject, (v) All pass, (vi) Phase Shift oscillator, (vi) Wein Bridge Oscillator. 7. To design, assemble and test the Multivibrators using Op-Amp: (i) Schmitt Trigger, (ii) Monostable Multivibrator, (iii) Bistable Multivibrator, (iv) Astable Multivibrator. 8. To operate Timer IC 555/556 as (i) Schmitt Trigger, (ii) Monostable Multivibrator, (iii) Bistable Multivibrator, (iv) Sequence Timer. **Digital Electronics**: The laboratory course can have any 5 experiments from the following list.

	1. Verify the truth tables of Logic Gates, Boolean laws and D Morgan's theorem. 2. Realization of combinational circuits (Decoders/Encoders/Code Converters). 3. Realization of Flip Flops using Logic Gates. 4. Design of counters using IC's: Up down, Decade, Synchronous, Binary, BCD counter. 5. Study of D/A and A/D converters (Any one of each class): R-2R ladder, weighted resistor method, successive approximation, voltage to frequency conversion. 6. Design of decoder driver to drive 7 segment LED display. 7. Interfacing of CMOS TTL logic families. 8. To design and test the given electronic application.

Numerical Methods and Computer Programming						
Course Code	**[EE-24007]**		**Examination Scheme**			
Teaching Scheme	1-2-1		**Theory**			
Credits	2		**Laboratory**	CIE: 50	ESE: 50	--

Course Outcomes:

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

1. Understand the importance and applications of numerical methods.
2. Apply various numerical methods for analysis of Electrical Engineering problems.
3. Solve non-linear equations of higher order which are frequently used in solving practical engineering problems.
4. Apply mathematics in engineering problems.
5. Develop C, C++ or MATLAB/Python programs for numerical methods.

Unit 1	**(2 Hrs)**
Introduction: Mathematical modeling in engineering problem solving, Approximations and different types of errors, Introduction to MATLAB programming, introduction to Scilab.	
Unit 2	**(4 Hrs)**
Simultaneous Algebraic Equations: Roots of algebraic and transcendental equations, Bracketing methods – bisection method, false position, Open methods – Newton Raphson, application: Analysis of electrical circuits using above methods, Cramer's rule, Gauss elimination – pit falls and remedies, Gauss-Seidal, Gauss-Jordan method, Newton Raphson method, Application: solving resistive networks.	
Unit 3	**(3 Hrs)**
Curve Fitting: Interpolation , Extrapolation- Newton's polynomial, Lagrange polynomial	
Unit 4	**(5Hrs)**
Numerical Differentiation and Integration:	

Euler's method, Modified Euler's method, Runge-kutta methods.
Integration: Trapezoidal rule, Simpson's Rule, Application: calculation of RMS values.

Text Books:

- Steven Chapra, Raymond P. Canale," Numerical Methods for Engineers", Tata McGraw-Hill Education, 8th Edition
- Santosh K. Gupta,"Numerical Methods for Engineers", New Age Publishers, 4th edition.
- S. S. Sastry, "Introductory Methods of Numerical Analysis", Prentice India Learning Pvt. Ltd., 5th edition.

Reference Books:

- E.Bala Guruswamy,"Numerical Methods", Tata McGraw-Hill Education, 2009.
- Rudra Pratap, "MATLAB:An Introduction with Applications", Wiley Publishers, 4th Edition.

e Learning Resources:

- http://www/nptelvideos.in/2012/11/numerical-methods-and-programming.html.
- http://www.nptelvideos.in/11/numerical-methods-and-computation.html.
- https://npte.ac.in/courses/122106033.

Term work:

It shall comprise of minimum 10-12 programs in MATLAB/Phyton/C++ for solving problems demonstrating use of various numerical methods learned in above 6 units.

S.Y. B.Tech. (Semester III) – Indian Language: Sanskrit			
Course Code		**Scheme of Evaluation**	**CIE**
Teaching Plan	0-0-0-2	**CIE**	100
Credits	2	**END Semester**	----

Syllabus: Course outcomes:
On satisfying the requirements of this course, students will have the knowledge and skills to:
1. Familiarize themselves with the basic grammatical categories of Sanskrit.
2.Form simple sentences in Sanskrit.
3. Understand and extract the meaning of the prescribed Sanskrit scientific texts.
4. Co-relate the significance of the scientific literature with the modern knowledge.

Unit	Contents	L
01.	Introduction to the Sanskrit phonology Sandhi- Guṇa, Vr̥ddhi, Yaṇ, Savarṇadīrgha Introduction to persons, numbers and the present tense. Introduction to Kāraka and Vibhaktis- 1. Prathamā - Dvitīyā 2. Tr̥tīyā – Caturthī	**7**
02.	Introduction to the past tense and the imperative and potential moods Introduction to Kāraka and Vibhaktis-	**7**

	1. Pañcamī 2. Śaṣṭhī 3. Saptamī Introduction to Samāsa	
03.	Janapadaniveśa - KauṭilīyaArthaśāstra + Rasaratnasamuccaya	**7**
04.	Chapter 1 of the Līlāvatī (up to square roots)	**7**

Suggested learning resources:
1. V. S. Apte, The student's Sanskrit to English dictionary, 2015. MotilalBanarasidass
2. A. A. Macdonell, A Sanskrit English dictionary, 1893, Oxford press.
3. V. S. Apte, The student's English to Sanskrit dictionary, 2014. MotilalBanarasidass
4. Samskṛt- Śabdadhātu- Rūpāvali, Navneet publications.
5. R. D. Desai, Sanskrit pravesha, 2017, Continental prakashan.
6. Madhav Deshpande, Samskṛtsubodhinī, 2007, University of Michigan.
7. Web Sanskrit Dictionary based on ``The Practical Sanskrit-English Dictionary" by VamanShivaramApte. - http://www.aa.tufs.ac.jp/~tjun/sktdic/
8. Shankar Lal Hari Shankar, RasaRatnaSamucchaya of Vagbhatacharya, 2019, KhemrajShrikrushnadasPrakashan.
9. Colebrook, English translation of the Līlāvatī, (with notes by Banerjee), 1893, Thacker spink&co.
10. Līlāvatī, KhemrajShrikrushnadas, 1908, Shri Venkateshvar steam press Mumbai.
11. R. Shamasastry, Kautilya'sArthashastra, 1915, Bangalore: Government Press.
12. R. Shamasastry, editor: Ashok Kumar Shukla - with Sanskrit Text, Kautilya'sArthashastra, 1915, Bangalore: Government Press.
13. Read Kautilya'sArthashastra for free on: https://www.wisdomlib.org/hinduism/book/kautilya-arthashastrasanskrit/ d/doc905574.html

Indian Language: Pali

Course Code	<tbd>	**Scheme of Evaluation**	**CIE**
Teaching Plan	0-0-0-2	**CIE**	100
Credits	2	**END Semester**	----

Syllabus:
Course outcomes:
On satisfying the requirements of this course, students will have the knowledge and skills to:
1.become acquainted with some literary specimens of Pali literature in prose and poetry.
2.learn ancient Indian moral, humanitarian and scientific values.
3.develop interest in Pali language and literature
4.learn to appreciate the Indian literary heritage

Unit	Contents	L
01.	Introduction to Pali: What is Pali? Its origin and homeland; Pali	**7**
	Literature: Early Phase, Commentarial Phase and Post commentarial	
	Phase	
02.	Introduction to Grammar: Alphabets, Pronunciation, Phonetic variation;	**7**
	Noun, Verb and Sentence formation	
03.	Selected Prose: Nakkhattajātaka, Vīmaṃsakasutta, Kālāmasutta,	**7**
	Vitakkasaṇṭhānasutta	
04.	Selected Poetry: Selected portion from Dhammapada, Puṇṇikātherī,	**7**
	Kumbhajātaka with pronunciation and recitation	

Suggested learning resources:

1. B. Mahadevan, Bhat Vinayak and NagendraPavan R.N., 'Introduction to IndianKnowledge Systems : Concepts and Applications'
2. Dharmapal 'Indian Science and Technology'
3. Kapil Kapoor, Singh Avdhesh Kumar, 'Indian Knowledge Systems'
4. Chattopadhyaya, Debiprasad, History of science and technology in ancient India: the beginnings, Firma KLM Pvt. Ltd. 1986.
5. Irfan Habib (ed.), People's History of India – Vol 20 : Technology in Medieval India, c. 650–1750, Aligarh Historians Society and Tulika Books, 2016.
6. Jan Gonda, A History of Indian Literature, Otto Harrassowitz, Wiesbaden, 1975.
7. L. Gopal and V. C. Shrivastava, History of Agriculture in India (Upto 1200 A. D.), Concept Publishing, New Delhi, 2008.
8. PushkarSohoni, Introduction to the History of Architecture in India, IISER, Pune, 2020.
9. SurendranathDasgupta, A History of Indian Philosophy, Cambridge University press, 1922.
10. RadhavallabhTripathi, Vāda in theory and practice : studies in debates, dialogues and discussions in Indian intellectual discourses, IIAS, Shimla, 2016.
11. ThanuPadmanabhan (ed.), Astronomy in India : A Historical Perspective, Indian National Science Academy, Springer, New Delhi. 2014.

(VEC)- Environmental Studies			
Course Code	<tbd>	**Scheme of Evaluation**	**CIE**
Teaching Plan	1--0-0-1	**CIE**	100
Credits	1	**END Semester**	----

Syllabus:

Course outcomes:

Students will be able to

1.Aware about different sustainable techniques for conservation and management of natural resources and importance of studying sustainable development goals

2.Aware about sources of different kinds of pollution and its types, sensitize themselves to adverse health impacts of pollution and knowing the techniques of pollution prevention and management
3.Aware about factors impacting biodiversity loss and ecosystem degradation in India and the world & major conservation strategies taken in India, importance of biodiversity and their role in conserving biodiversity
4.Aware about Climate change with reference to impacts, adaptation & mitigation strategies
5.Learn about Environmental management system, Environmental legislation, policies, international treaties etc and our country's stand on and responses to the major international agreements. Major international institutions and programmes and the role played by them in the protection and preservation of the environment.

Unit	Contents	L
01.	**Humans and the Environment:**	**1**
	The man-environment interaction: Humans as hunter-gatherers; Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment; Middle Ages and Renaissance; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation; Global environmental change. The emergence of environmentalism: Anthropocentric and eco-centric perspectives (Major thinkers); The Club of Rome- Limits to Growth; UN Conference on Human Environment 1972; World Commission on Environment and Development and the concept of sustainable development; Rio Summit and subsequent international efforts.	
02.	**Natural Resources and Sustainable Development**	**2**
	Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable. Biotic resources: Major type of biotic resources- forests, grasslands, wetlands, wildlife and aquatic (fresh water and marine); Microbes as a resource; Status and challenges. Water resources: Types of water resources- fresh water and marine resources; Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges; Water scarcity and stress; Conflicts over water. Soil and mineral resources: Important minerals; Mineral exploitation; Environmental problems due to extraction of minerals and use; Soil as a resource and its degradation. Energy resources: Sources of energy and their classification, renewable and non-renewable sources of energy; Conventional energy sources- coal, oil, natural gas, nuclear energy; Non-conventional energy sources- solar, wind, tidal, hydro, wave, ocean thermal, geothermal, biomass, hydrogen and fuel cells; Implications of energy use on the environment. Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs.	
03.	**Environmental Issues: Local, Regional and Global**	**2**
	Environmental issues and scales: Concepts of micro-, meso-, synoptic and planetary scales; Temporal and spatial extents of local, regional, and global phenomena. Pollution: Impact of sectoral processes on Environment, Types of Pollution- air, noise, water, soil, municipal solid waste, hazardous waste; Transboundary air pollution; Acid rain; Smog. Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Biodiversity loss: past and current trends, impact. Global change: Ozone layer depletion; Climate change.	
04.	**Conservation of Biodiversity and Ecosystems:** Biodiversity and its distribution: Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Species and ecosystem threat categories. Ecosystems and ecosystem services: Major ecosystem types in India and their basic characteristics forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance. Threats to biodiversity and ecosystems: Land use and land cover change;	**2**

	Commercial exploitation of species; Invasive species; Fire, disasters and climate change.	
05.	**Environmental Pollution and Health**	**2**
	Understanding pollution: Production processes and generation of wastes; Assimilative capacity of the environment; Definition of pollution; Point sources and non-point sources of pollution. Air pollution: Sources of air pollution; Primary and secondary pollutants; Criteria pollutants- carbon monoxide, lead, nitrogen oxides, ground-level ozone, particulate matter and sulphur dioxide; Other important air pollutants- Volatile Organic compounds (VOCs), Peroxyacetyl Nitrate (PAN), Polycyclic aromatic hydrocarbons (PAHs) and Persistent organic pollutants (POPs); Indoor air pollution; Adverse health impacts of air pollutants; National Ambient Air Quality Standards. Water pollution: Sources of waterpollution; River, lake and marine pollution, groundwater pollution; water quality Water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life. Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health. Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health. Thermal and radioactive pollution: Sources and impact on human health and ecosystems.	
06.	**Climate Change: Impacts, Adaptation and Mitigation**	**2**
	Understanding climate change: Natural variations in climate; Structure of atmosphere; Anthropogenic climate change from greenhouse gas emissions– past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Climate change projections for the Indian sub-continent. Impacts, vulnerability and adaptation to climate change: Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health, urban infrastructure; the concept of vulnerability and its assessment; Adaptation vs. resilience; Climate-resilient development; Indigenous knowledge for adaptation to climate change. Mitigation of climate change: Synergies between adaptation and mitigation measures; Green House Gas (GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality; National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future; Energy efficiency measures; Renewable energy sources; Carbon capture and storage, National climate action plan and Intended Nationally Determined Contributions (INDCs); Climate justice.	
07.	**Environmental Management**	**2**
	Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control.	
	Environmental management system: ISO 14001, Life cycle analysis; Cost-benefit analysis, Environmental audit and impact assessment; Environmental risk assessment, Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling /Ecomark scheme	
08.	**Environmental Treaties and Legislation**	**2**
	Major International organizations and initiatives: United Nations Environment Programme (UNEP), International Union for Conservation of Nature (IUCN),World Commission on Environment and Development (WCED), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC), and Man and the Biosphere (MAB) programme.	

09.	**Case Studies and Field Work**	**1**
	Discussion on one national and one international case study related to the environment and sustainable development.	
	Field visits to identify local/regional environmental issues, make observations including data collection and prepare a brief report.	
	Documentation of campus biodiversity, Campus environmental management activities such as solid waste disposal, water management and sewage treatment	

Suggested learning resources:
1. Hughes, J. Donald (2009) An Environmental History of the World- Humankind's Changing Role in the Community of Life, 2nd Edition. Routledge.
2. Gilbert M. Masters and W. P. (2008). An Introduction to Environmental Engineering and Science, Ela Publisher (Pearson)
3. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press.
4. Krishnamurthy, K.V. (2003) Textbook of Biodiversity, Science Publishers, Plymouth, UK
5. Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education.
6. Pittock, Barrie (2009) Climate Change: The Science, Impacts and Solutions. 2nd Edition. Routledge.

(HSMC) Principles of Entrepreneurship	
Teaching Scheme Lectures: 2 Hrs./week Self Study:1 Hr / week	**Examination Scheme** Mid Sem Evaluation - 30 Marks TA-20 Marks End Sem Exam- 50 Marks

Syllabus:
Course Outcomes
Students will be able to
1.Enable the students to understand the concept of Entrepreneurship and to learn the professional behaviour expected of an entrepreneur.
2.Identify significant changes and trends which create business opportunities and to analyse the environment for potential business opportunities.
3.Provide conceptual exposure on converting idea to a successful entrepreneurial firm

Unit	**Contents**	**L**
01.	Entrepreneurship: Meaning of entrepreneurship – Types of Entrepreneurships – Traits of entrepreneurship – Factors promoting entrepreneurship- Barriers to entrepreneurship- the entrepreneurial culture- Stages in entrepreneurial process – Women entrepreneurship and economic development- SHG.	**6**
02.	Developing Successful Business Ideas: Recognizing opportunities – trend analysis – generating ideas – Brainstorming, Focus Groups, Surveys, Customer advisory boards, Day in the life	**6**

	research – Encouraging focal point for ideas and creativity at a firm level-Protectingideas from being lost or stolen – Patents and IPR.	
03.	Opportunity Identification and Evaluation Opportunity identification and product/service selection – Generation and screening the project ideas – Market analysis, technical analysis, Cost benefit analysis and network analysis- Project formulation – Assessment of project feasibility- Dealing with basic and initial problems of setting up of Enterprises.	**6**
04.	Business Planning Process Meaning of business plan- Business plan process- Advantages of business planning preparing a model project report for starting a new venture (Team-based project work)	**5**
05.	Funding Sources of Finance- Venture capital- Venture capital process- Business angles Commercial banks- Government Grants and Schemes.	**5**

Suggested learning resources:
1. Reddy, Entrepreneurship: Text & Cases - Cengage, New Delhi.
2. Kuratko/rao, Entrepreneurship: a south asianperpective.- Cengage, New Delhi.
3. Leach/Melicher, Entrepreneurial Finance – Cengage. , New Delhi.
4. K.Sundar – Entrepreneurship Development – Vijay Nicole Imprints private Limited
5. Khanka S.S., Entrepreneurial Development, S.Chand& Co. Ltd., New Delhi, 2001.
6. Sangeeta Sharma, Entrepreneurship Development, PHI Learning Pvt. Ltd., 2016.
7. P. Khanna, "Industrial Engineering and Management", Dhanpatrai publications Ltd, New Delhi.
8. Barringer, B., Entrepreneurship: Successfully Launching New Ventures, 3rd Edition, Pearson, 2011.
9. Bessant, J., and Tidd, J., Innovation and Entrepreneurship, 2nd Edition, John Wiley &Sons, 2011.
10. Desai, V., Small Scale Industries and Entrepreneurship, Himalaya Publishing House, 2011.
11. Donald, F.K., Entrepreneurship- Theory, Process and Practice, 9th Edition, Cengage Learning, 2014.

(HSMC) Design Thinking and Idea Lab (DTIL)			
Course Code	<tbd>	**Scheme of Evaluation**	**CE & ESE**
Teaching Plan (L-T-P-S)	0-0-2-1	**MID Semester**	Individual Assignments/Group tasks- 40 marks Class/team participation- 10 marks
Credits	1	**END Semester**	Project Based Learning (PBL)- 50 marks (50 – PBL & 10 participation

Syllabus:
Course outcomes:
Students will be able to
1.Outline various learning styles and psychological principles and Infer Design Thinking principles & methodology.
2.Explain the levels of designs and Experiment with the process using human centric tools.

3. Propose real-time innovative engineering product designs and Choose appropriate frameworks, strategies, techniques for prototype development.
4. Appraise user feedback and Propose corrective innovative solutions to meet project requirements using critical thinking skills.

Unit	Contents	Practical
	Part 1- THINKING (Methodology of Design Thinking)	
01.	**An Insight to Learning** Experiential Learning Styles, Self-assessment Psychological Principles in Design Thinking Perception & Observation, Imagination & Creative Confidence (lateral thinking & 6 thinking hats)	**4**
02.	**Design Thinking Framework** Introduction to different frameworks of DT, Stanford d. school framework Empathize, Define, Ideate, Prototype, Test Case Study: IDEO Shopping Cart, etc.	**2**
03.	**User-Design Relationship** Levels of Designs Understanding users through interviews, personas, empathy maps/affinity diagrams/journey maps and need identification	**4**
04.	**Introduction to Human Centric Tools in Design Thinking Process** Brainstorming & Mind mapping POV and HMW	**2**
	Part 2- DESIGN (Idea Lab) Applications of the Principles- Department Level	
05.	**Process of Product Design** Process of simple Product Design using real life problem statements from our daily routine activities, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions. Hands on Lab Assignment –Simple routinely used Product Design. Hands on demonstration of how to translate the ideas into physical objects. Better visualization of the ideas and concepts using, IDEA LAB/FAB LAB facilities such as Wood router, Laser cutting of thin plastic sheets, clay modelling, Expandable Polystyrene etc	**2**
06.	**Prototyping** What is Prototype? Understanding necessity of making prototypes by building the prototypes for pre-selected Engineering problem, using one or combinations of the digital fabrication techniques & electronics fabrication systems.	**4**
07.	**Testing** Testing, Sample Example, Test Group Marketing Feedback, Re-Design & Re-Create	**2**
08.	**Feedback, Re-Design & Re-Create** Final Presentation – "Solving Practical Engineering Problem through Innovative Product Design & Creative Solution"	**2**

Suggested Learning Resources:

1. Norman, D. (2013). The Design of Everyday Things. Basic Books, NY.
2. Norman, D. (2004). Emotional Design. Basic Books, NY.
3. Brown, T. (2019). Change by Design. HarperCollins Publishers, NY.
4. Lal, D. M. (2021). Design Thinking- Beyond the Sticky Notes. Sage Publications India Pvt. Ltd.
5. Malik, A. D. M. (2019). Design Thinking for Educators. Notion Press, Chennai, India.

6. E. F. Crawley, "Creating the CDIO Syllabus, a universal template for engineering education," *32nd Annual Frontiers in Education*, Boston, MA, USA, 2002, pp. F3F-F3F, doi: 10.1109/FIE.2002.1158202.
7. Dym, C. L., Agogino, A. M., Eris, O., Frey, D. D., &Leifer, L. J. (2005). Engineering design thinking, teaching, and learning. *Journal of engineering education*, *94*(1), 103-120.
8. Panke, S. (2019). Design thinking in education: Perspectives, opportunities and challenges. *Open Education Studies*, *1*(1), 281-306.
9. Parmar, A. J. (2014, October). Bridging gaps in engineering education: Design thinking a critical factor for project based learning. In *2014 IEEE frontiers in education conference (FIE) proceedings* (pp. 1-8). IEEE.
10. Thompson, L., &Schonthal, D. (2020). The Social Psychology of Design Thinking. California Management Review, 62(2), 84–99. https://doi.org/10.1177/0008125619897636

Direct S.Y. B.Tech. Semester III (All branches)

Matrices, Differential Calculus and Probability (MDCP)						
Course Code	**[EE-24001]**		**Examination Scheme**			
Teaching Scheme	3-1-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	3		**Laboratory**	CIE: 50	ESE: 50	--

Syllabus: Outcomes: Students will be able to
1.Define matrices, linear equations, and determinants, **recall** basics of probability theory, probability distribution, gradient, divergence and curl, Laplace Transform, ODE and PDE.
2.Identify types of ordinary differential equations and partial differential equations, **state** the formulae for Fourier coefficients, basic concepts of probability, probability distributions, Laplace Transform.
3.Solve ODEs and PDEs, **find** Fourier series expansions, **analyze,** and **calculate** eigen values, eigen vectors, **evaluate** probability of compound events, **find** probabilities using standard distributions, **solve** ODE using Laplace Transform.
4.Provetheorems, **solve** theoretical problems.
5.Apply concepts of ODE and PDE, Matrix algebra, Calculus and Probability to various problems including real life problems.

Unit	**Contents**	**L+T+S**
01.	**Matrix Algebra:** Properties of Matrices and Determinants, Solutions of Systems of linear equations using Gauss Elimination method, Eigen Values and Eigen Vectors. **S:** Properties of Matrices and Determinants	**6+0+3**
02.	**Vector Differential Calculus:** Functions of several variables (Domain and Range), PartialDerivatives,TheChainRule, Vector differentiation, gradient, divergence, and curl. **S:** Review of Vector Algebra	**6+0+3**
03.	**Ordinary Differential Equations:**	**12+0+6**

	First order Ordinary Differential Equations - Variable Separable, Homogeneous, Linear; Higher order linear equations with constant coefficients, non-homogeneous higher order linear differential equations with constant coefficients: method of variation of parameters; Applications to Initial value problems: Simple Electrical Circuits. Definition of Laplace Transform, Laplace Transform of standard functions, basic properties to solve ODE: linearity and LT of derivatives. **S:** First order Ordinary Differential Equations - Variable Separable, Homogeneous ODEs	
04.	**PartialDifferential Equations:** Fourier Series; Partial differential equations. Initial and Boundary value problems by separation of variables method, boundary value problems: Vibration of string: one dimensional wave equation. **S:** Types of PDEs	**8+0+4**
05.	**Probability:** Mean, median, mode, standard deviation, combinatorial probability, compound, and conditional probability. Probability distributions, Binomial distribution, Poisson distribution, Normal distribution. **S:** Compound and conditional probability.	**8+0+4**

Note 1:

- To measure CO1, questions may be of the type- define, identify, state, match, list, name etc.
- To measure CO2, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.
- To measure CO3, questions will be based on applications of core concepts.
- 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.
- To measure CO5, some questions may be based on self-study topics and also comprehension of unseen passages.

Textbook:

- Advanced Engineering Mathematics (10^{th} edition) by Erwin Kreyszig, Wiley Eastern Ltd.
- Thomas's Calculus (12th edition) by Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education.

Reference Books:

Calculus for Scientists and Engineers by K.D Joshi, CRC Press.

- A course in Calculus and Real Analysis (1^{st} edition) by Sudhir Ghorpade and Balmohan Limaye, Springer-Verlag, New York.
- Applied Mathematics Vol.1 (Reprint July 2014) by P.N. Wartikar and J.N. Wartikar, Pune Vidhyarthi Griha Prakashan Pune.
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Power Electronics and Machines						
Course Code	**(OE-2)**		**Examination Scheme**			
Teaching Scheme	2-1-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	2		**Laboratory**	CIE: 00	ESE: 00	--

Course Outcomes

Students will be able to:

1. Understand basic operation of power electronic devices.
2. Identify common power converters and their applications.
3. Explain operation of DC motor drives.
4. Explain operation of AC motor drives.
5. Select suitable drives for simple practical applications.

Unit 1: Power Semiconductor Devices (04 Hrs)

Basics of power semiconductor devices, construction and working of Diode, **SCR**, Power MOSFET and IGBT, basic characteristics and simple triggering concept of SCR, comparison of MOSFET and IGBT, and applications of power devices in drives, solar systems and electric vehicles.

Unit 2: Power Converters (06 Hrs)

Basic concept of power conversion and classification of converters, AC–DC converters, DC–AC converters , DC–DC converters and AC-AC voltage controller operation with loads (R, RL), and applications in battery charging, solar power systems and UPS.

Unit 3: Electrical Drive Selection and Applications (05 Hrs)

Concept of electrical drive selection, factors affecting selection such as load characteristics, speed and power requirements, selection of motors for different applications i.e. electric vehicles and household appliances with emphasis on energy efficiency.

Unit 4: DC Motor Drives (05 Hrs)

Basic structure of electric drive, working principle of DC motor, torque-speed characteristics, methods of speed control (armature and field control), and applications of DC drives in industries such as cranes, elevators and electric vehicles.

Unit 5: Induction Motor Drives (05 Hrs)

Working principle of induction motor, torque-speed characteristics, starting methods of squirrel cage motors, basic speed control methods, introduction to V/f control, and applications in fans, pumps and compressors.

Text Books:

- G.K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, New Delhi , 2001
- Harish C.N.K.De and P. K. Sen, Electric Drives, PHI Learning Pvt. Ltd., New Delhi , 1999)

Reference books:

- S. K. Pillai, A First Course in Electrical Drives, New Age International, New Delhi , 1994
- Vedam Subrahmanyam, Electric Drives: Concepts and Applications, New Age International, New Delhi , 2005

e Learning Resources:

- https://archive.nptel.ac.in/courses/108/104/108104140/

Electrical Design & Estimation Laboratory (VSEC)						
Course Code			**Examination Scheme**			
Teaching Scheme	2-1-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	2		**Laboratory**	CIE: 00	ESE: 00	--

Course Outcomes: Students will be able to:
1. Understand the design considerations and standards used in electrical installations.
2. Perform load calculations and select suitable cables and protection devices.
3. Prepare estimation and costing for residential and commercial electrical installations.
4. Design illumination schemes and perform basic lighting calculations.
5. Develop electrical layouts and apply Indian Standards and IE rules in practical design.
Unit 1: Fundamentals of Electrical Design & Safety Standards [7 Hrs]
Electric supply systems, Three-phase four-wire distribution system, Types of electrical loads, Systems and methods of wiring, Service mains and sub-circuits, Indian Electricity Rules (1656/2005), NEC (2023) and IS standards, Location of switches, DBs, and control panels, Earthing Systems IS:3043, Lightning Protection
Unit 2: Electrical Load Assessment and Distribution Design [7 Hrs]
Connected load and maximum demand, Demand factor and diversity factor, Load assessment methods, Selection of conductor size, Permissible voltage drop, Selection of cables, Selection of protective devices: MCB, MCCB, Fuse, Distribution board design.
Unit 3: Commercial & Multi-Storey Building Design [7 Hrs]
Design for offices, hospitals, or malls. Substation planning: Indoor/outdoor substations, selection of

transformers (up to 750 kVA), and HT/LT panel design. Power factor improvement and capacitor bank sizing. Introduction to Fire Alarm Systems (FAS).
Unit 4: Estimation and Costing of Electrical Installations [5 Hrs]
Principles of estimation and costing, Estimation of residential installations, Estimation of commercial installations, Preparation of schedule of materials, Preparation of BOQ (Bill of Quantities) with current market rates, EMD, SECURITY DEPOSIT, Cost analysis and tender preparation,
Unit 5: Modern Design Practices and Electrical Drafting [6 Hrs]
Electrical symbols and layouts, Single-line diagrams, Electrical wiring layouts for buildings, Introduction to AutoCAD/electrical drafting software, Earthing considerations in design, Testing and inspection requirements for installations.
List of Experiments:
Students will perform any eight experiments:
1. Study of electrical installation accessories and protective devices
2. Drafting an SLD and layout for a 3BHK residential unit using AutoCAD Electrical.
3. Preparation of an automated BOQ in MS Excel for a commercial installation.
4. Load calculation and cable sizing for residential building
5. Design of single-line diagram for a small installation
6. Estimation and costing of residential wiring installation
7. Estimation of commercial electrical installation
8. Illumination design of a room using lumen method
9. Preparation of electrical layout using CAD software
10. Selection of protective devices for electrical installation
Textbooks:
[1] J.B. Gupta — A Course in Electrical Installation Estimation and Costing
[2] S.L. Uppal — Electrical Wiring Estimating and Costing
[3] Bill Atkinson — Electrical Installation Designs
Reference Books:
[1] McPartland — Handbook of Practical Electrical Design
[2] Stokes — Handbook of Electrical Installation Practice
[3] IS Codes and IE Rules Handbook

[EE] PLCs for Industrial Automation	
Teaching Scheme Lectures:2 Hrs./week Practical:4Hrs/week	**Examination Scheme** Mid Semester Evaluation- 30 Marks TA – 20 Marks End Semester Evaluation - 50 Marks

Course Outcomes:

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

1. Identify the building blocks and develop architecture for designing a given automation system
2. Develop ladder diagram for a given application
3. Select appropriate PLC and design system for specific application
4. Identify HMI for particular automation examples.
5. Develop skills that are highly relevant to industries employing PLC-based automation systems, such as manufacturing, process control etc.

Unit 1	**(7Hrs)**
Introduction to Industrial Automation: Importance of Industrial Automation, historical development, Automation Hierarchy, Building blocks of automation systems, description of each component. Types of automation systems:-fixed and programmable. Different systems for Industrial automation, examples of automation such as cement plant etc., Introduction to various sensors,	
Unit 2	**(7Hrs)**
PLC Fundamentals: Building Blocks of PLC: CPU, Memory organization, Input-output modules (discrete and analog), Special I/O Modules, Power supply. Fixed and Modular PLC and their types, Redundancy in PLC module. I/O module selection criteria Interfacing different I/O devices with appropriate I/O modules.	
Unit 3	**(7Hrs)**
PLC Programming: PLC I/O addressing. PLC programming Instructions: Relay type instructions, timer instructions: Comparison Instructions. Data handling Instructions. Ladder Programming, communications systems such as LAN, CANBUS, Profibus, fieldbus etc	
Unit 4	**(7Hrs)**
PLC Applications: Simple Programming examples using ladder logic: Timer, Motor sequence control, Traffic light control, elevator control, Tank level control, conveyor system, Specifications of various PLC available in the Market	

List of Recommended Books:

- Petruzella, F. (2023). Programmable Logic Controllers (6th ed.). Tata-McGraw Hill India.
- Fundamentals of Programmable Logic Controllers , January 2019by Vijay Singh (Author)
- Webb, J. W., & Reis, R. A. (1999). Programmable Logic Controllers: Principles and Applications.
- Erickson, K. T. (2016). Programmable Logic Controllers: An Emphasis on Design and Application.

e-Learning resources:

- Nptel course on Industrial Automation and Control, IIT Kharagpur by Prof. S. Mukhopadhyay, Prof. S. Sen

Clean and Green Energy EE[MDM- 01]						
Course Code			**Examination Scheme**			
Teaching Scheme	3-1-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	3		**Laboratory**	CIE: 00	ESE: 00	--

Course Outcomes: Students will be able to:

1. Appreciate the importance of clean and green energy resources and their role in sustainable development.

2. Analyze various applications of solar energy systems.

3. Analyze wind, hydro, biomass, and other renewable energy technologies for power generation.

4.Evaluate emerging green energy technologies such as fuel cells, smart grids, and electric vehicles.

5.Apply energy management and conservation techniques to reduce environmental impact and improve sustainability.

Unit 1: Introduction to Energy and Environment: (5 hrs)

Energy sources: Conventional and non-conventional energy ,Global energy scenario and energy crisis ,Environmental impacts of fossil fuels ,Climate change and greenhouse effect ,Sustainable development and green energy concepts ,Energy policies and regulations

Unit 2: Solar Energy Systems: (7 hrs)

Solar radiation and measurement ,Solar thermal energy systems, Solar photovoltaic (PV) systems,Solar water heaters and solar cookers ,Grid-connected and standalone PV systems, Applications and advantages of solar energy

Unit 3: Wind, Hydro, and Biomass Energy: (7 hrs)

Wind energy conversion systems,Wind turbines and power generation,Small hydro power plants,Biomass energy sources and conversion methods, Biogas plants and biofuels,Waste-to-energy technologies

Unit 4: Emerging Green Energy Technologies: (7 hrs)

Hydrogen energy and fuel cells, Geothermal energy,Ocean energy: Tidal and wave energy ,Electric and hybrid vehicles, Smart grids and energy storage systems ,Green buildings and energy efficiency

Unit 5: Energy Management and Sustainability: (6 hrs)

Carbon footprint and carbon trading, Sustainable energy planning, Environmental impact assessment, Case studies on renewable energy projects.

Text Books:

- P. Mondal, Technologies for clean and renewable energy production. Available at- https://drive.google.com/file/d/17vQiXJkTt9PqV8emokFJuCgiptyhonxr/view
- S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009
- Rai. G.D, "Non conventional Energy Sources", Khanna publishes, 1993.
- G. M. Masters, Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004
- S. P. Sukhatme, Solar Energy: Principles of Thermal Collection and Storage‖, McGraw Hill, 1984.

Reference Books:

- John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
- C. S. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, 3rd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2015.

- Gray, L. Johnson, “Wind Energy System”, prentice hall of India, 1995
- B.H.Khan, " Non-conventional Energy sources", Mc Graw-hill, 2nd Edition, 2009.
- Fang Lin Luo Hong Ye, " Renewable Energy systems", Taylor & Francis Group,2013
- M. R. Patel, Wind and Solar Power Systems: Design, Analysis, and Operation, 2nd ed. Boca Raton, FL, USA: CRC Press, 2006.
- C. S. Solanki, Renewable Energy Technologies: A Practical Guide for Beginners. New Delhi, India: PHI Learning Pvt. Ltd., 2009.