



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

Master of Science Electronics and Communication Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2S02NCELC01	Electromagnetics and Antenna Technology	3-0-1	120	04

- **Course Learning Outcomes (CLOs)** On completion of this course, students will be able to:

CLO 1:.	Explain the fundamental electromagnetic laws, Maxwell's equations and vector calculus to analyze and solve problems in electrostatics, magnetostatics and time- varying fields using mathematical formulations with conceptual understanding of energy fields
CLO 2:.	Evaluate electromagnetic wave propagation in different media, calculate wave parameters and apply Poynting's theorem for energy analysis, with interpretation of wave behavior as structured vibrations and resonance.
CLO 3:.	Design various antennas (dipole arrays, Yagi-Uda, horn, parabolic reflectors); calculate antenna parameters and select appropriate systems for communication applications, correlating antenna resonance and radiation with structural resonance concepts
CLO 4:.	Design and analyse Transmission lines using telegraphic equations and Smith charts, design matching devices for RF/microwave circuits, incorporating principles of wave transmission and resonance analogous to vibration-based systems.
CLO 5:.	Analyze TE/TM modes in rectangular and circular waveguides; evaluate waveguide components including junctions, isolators, and circulators, with understanding of guided and directional energy propagation in light of traditional insights on wave behavior.
CLO 6:.	Analyze microwave tubes, solid-state devices and detectors, evaluate their suitability for communication and radar applications, integrating interdisciplinary understanding of wave-matter interaction.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Electromagnetic Field Theory and Wave Propagation: Introduction of Electromagnetics, Pancha Mahabhuta : Concept of Space (Akasha) and Energy Fields, Electrostatics – Review of Laws of Electrostatics – Coulomb's Law, Proof of Gauss law on arbitrary surface, Poisson and Laplace equations, Green's Theorem, Potential energy and energy density. Magnetostatics – Biot-Savart law, Ampere's law, Energy density in magnetic field, Maxwell's equations : Integral and Differential Forms, Time - varying fields and Displacement current, Scalar and Vector Potential, Applications of Gauge transformations, Poynting's theorem and Energy flow.	CL, Seminars, Inquiry-Based Learning	CLO1, CLO2
II	Transmission Lines and RF Structures: Transmission line theory and Telegrapher's Equations, Nāda : Vibration and Wave Theory, Standing wave ,Reflection coefficient, VSWR, Smith Chart and its applications Types of Transmission lines :	CL, PBL, ICT-Enabled Learning	CLO3



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	Coaxial Cable, Twin wire line, Strip and Microstrip line, Impedance matching : Quarter and Half wavelength lines, Stubs and Baluns, RF passive components: Couplers, Filters, Attenuators.		
III	Waveguides and Microwave Engineering: Wave guides : Rectangular and Circular, Surya Siddhanta : Ancient Indian Insights on Light and Wave Propagation, Wave propagation in Rectangular and Circular waveguides, Wave-guide modes : Transverse Electric (TE) Mode, Transverse Magnetic (TM) Mode, Cutoff frequency, Waveguides components - Junctions, couplers, Cavity Resonators : Isolators and circulators, Matching and attenuations, Types of Microwave sources: Klystron, Magnetron, Traveling Wave Tube , Microwave Detectors : Gunn diode, PIN diode, Schottky diode.	CL, ICT-enabled learning,	CLO4
IV	Antenna Technology and Modern Applications: Radiation mechanism and antenna parameters, Resonance and Structural Response in Sthapatya Veda, Basic antennas: Dipole, Monopole, Loop, Antenna arrays and beamforming , Yagi-Uda, Log-periodic, Horn and Reflector antennas , Microstrip patch antenna (design concepts), MIMO and smart antennas, Antennas for 5G, IoT, RFID and wearable devices, Antenna measurement techniques.	CL, Seminars, CBL, Mini Projects	CLO5, CLO6

• Assessment Methodologies

(A) Internal Assessment

a. Internal Formative assessment

- MCQ and Objective question Quiz
- Seminar/Presentation and Group Discussion
- Assignments

b. Internal Summative Assessment

- Mid-term tests

(B) Weightage of Learning Efforts for External Assessment

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1, CLO2	30	3	3	8	14
II	CLO3	30	3	3	8	14
III	CLO4	30	2	2	7	11
IV	CLO5, CLO6	30	2	2	7	11
		120	10	10	30	50



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• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Mid Term Test, Class Regularity, Group Discussion	50
2	End-Semester Examination	Written Exam	50

(C) CLOs – PLOs Matrix

CLO	PLO										
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3	2	–	1	–	1	1	–	1	–	2
CLO2	3	2	–	1	1	2	1	–	–	–	1
CLO3	3	3	–	2	1	2	2	–	–	–	1
CLO4	2	1	–	3	2	2	2	1	–	1	2
CLO5	1	3	1	1	–	1	3	1	2	1	2
CLO6	2	3	2	1	–	1	3	2	2	2	3

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

• Suggested Learning Materials Books:

1. Electromagnetic Field Theory Fundamentals' Bhag Singh Guru, Huseyin Hiziroglu, Cambridge Publications.
2. Electromagnetic Field theory and Transmission Lines, G.S.N.Raju, Pearson Education.
3. Antenna Theory: Analysis and Design. Constantine A. Balanis, Wiley
4. Electronics Communications Systems, George Kennedy, McGraw Hill



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Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2S02NCELC02	Analog & Digital Communication	3-0-1	120	04

- **Course Learning Outcomes (CLOs)** On completion of this course, students will be able to:

CLO 1:.	Analyze analog communication using carrier transport theories and relate them to fundamental concepts of transmission and receiving the analog signals.
CLO 2:.	Analyze digital communication using carrier transport theories and relate them to fundamental concepts of transmission and receiving the digital signals.
CLO 3:.	To understand the basics of signals and transmission of various signal through encryption and decryption techniques applications will be introduced.
CLO 4:.	To improve scientific attitude and to give emphasis on the development of experimental skills, data analysis, calculations, and also on the limitations of the experimental method and data as well as results obtained
CLO 5:.	To study the combination of radio signal transmitted through analog or digital signal towards space.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Fourier series, Power Spectral Density, Convolution, Correlation between waveforms, Auto and Cross correlation, Sampling Theorem	CL, Seminars, Inquiry-Based Learning	CLO1, CLO2
II	Amplitude Modulation: Equation for AM, modulation index, spectrum of AM, DSB and SSB transmission with and without carriers, VSB transmission, DSB,C amplitude modulators, Envelope detectors, Balanced Modulator, SSB signal generation and Demodulation schemes. ASK, FSK, QAM, BPSK, QPSK, Transmitter and receiver block diagrams.	CL, PBL, ICT-Enabled Learning	CLO3
III	Equations for FM, modulation Index, spectrum calculation for sinusoidal waveform and Bessel's function table, phase modulation, relationship between FM and PM, NBFM and WBFM, frequency modulators and demodulators (Armstrong method) Types of noise : Noise in AM and FM systems	CL, ICT-enabled learning,	CLO4
IV	Various pulse modulation methods, Pulse code modulation PCM, Delta modulation DM. Comparison between PCM and DM, Companding method, Noise in digital systems.	CL, Seminars, CBL, Mini Projects	CLO5



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Assessment Methodologies

(D) Internal Assessment

a. Internal Formative assessment

- (d) MCQ and Objective question Quiz
- (e) Seminar/Presentation and Group Discussion
- (f) Assignments

b. Internal Summative Assessment

- (a) Mid-term tests

(E) Weightage of Learning Efforts for External Assessment

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1, CLO2	30	3	3	8	14
II	CLO3	30	3	3	8	14
III	CLO4	30	2	2	7	11
IV	CLO5	30	2	2	7	11
		120	10	10	30	50

Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Mid Term Test, Class Regularity, Group Discussion	50
2	End-Semester Examination	Written Exam	50

(F) CLOs – PLOs Matrix

CLO	PLO										
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3	2	–	1	–	1	1	–	1	–	2
CLO2	3	2	–	1	1	2	1	–	–	–	1
CLO3	3	3	–	2	1	2	2	–	–	–	1
CLO4	2	1	–	3	2	2	2	1	–	1	2
CLO5	1	3	1	1	–	1	3	1	2	1	2
CLO6	2	3	2	1	–	1	3	2	2	2	3



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Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

1. Modern digital and analog communication systems: B.P.Lathi, Holt,Sounders (HRW Series) Publication. 1987..
2. Electronic communications: Dennis Roddy and John Coolen, PHI 1995.
3. Communication systems: Haykin, John Wiley, 1994.



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Master of Science Electronics and Communication Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2S02NCELC03	Programming in C / C++	3-0-1	120	04

- **Course Learning Outcomes (CLOs)** On completion of this course, students will be able to:

CLO 1:.	Apply the basic concepts of C programming to solve practical problems
CLO 2:.	Demonstrate the use of aggregate data types along with their operations.
CLO 3:.	Utilize composite data types and implement functions for modular programming.
CLO 4:.	Develop programs incorporating exception handling techniques for robust and error-free execution.
CLO 5:.	Apply advanced C/C++ concepts programming, file handling, modules, and basic applications.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Program Design and Coding, Introduction to C language, constants, Variable and data types and storage classes, operators and their precedence, expression, Managing Input and Output. Decision Making and Branching- if-statement if-else statement, if-else if statement, Decision Making and looping - while loop, do – while loop	CL, Seminars, Inquiry-Based Learning	CLO1, CLO2
II	Arrays – one, two and multidimensional array, Handling of character Array (String). User defined functions – Types of User defined function, Nesting of function, Recursion, User derived data types – Structure and Union, structure and functions, Pointer, File Management in C, Command line argument.	CL, PBL, ICT-Enabled Learning	CLO3
III	C – Preprocessor – Preprocessor directives, Graphics, Programming in C – Resolution of screen, Aspect ratio, Display modes, Pixel, Drawing various objects, Animation, Dynamic memory allocation in C.	CL, ICT-enabled learning	CLO4
IV	Assembly level programming via C, Interrupts, Parallel and Serial I/O ports, Interfacing Mouse, Interfacing I/O port for Analog to Digital converter and Digital to Analog converter using C. Introduction to object oriented programming, The C++ Class and methods in C++, console I/O, Stack as an example in C++.	CL, Seminars, CBL, Mini Projects	CLO5

- **Assessment Methodologies**

(G) Internal Assessment

a. Internal Formative assessment

- (g) MCQ and Objective question Quiz
- (h) Seminar/Presentation and Group Discussion
- (i) Assignments

b. Internal Summative Assessment

- (a) Mid-term tests



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(H) Weightage of Learning Efforts for External Assessment

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1, CLO2	30	3	3	8	14
II	CLO3	30	3	3	8	14
III	CLO4	30	2	2	7	11
IV	CLO5	30	2	2	7	11
		120	10	10	30	50

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Mid Term Test, Class Regularity, Group Discussion	50
2	End-Semester Examination	Written Exam	50

(I) CLOs – PLOs Matrix

CLO	PLO										
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3	2	–	1	–	1	1	–	1	–	2
CLO2	3	2	–	1	1	2	1	–	–	–	1
CLO3	3	3	–	2	1	2	2	–	–	–	1
CLO4	2	1	–	3	2	2	2	1	–	1	2
CLO5	1	3	1	1	–	1	3	1	2	1	2
CLO6	2	3	2	1	–	1	3	2	2	2	3

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

• Suggested Learning Materials Books:

1. Programming in ANSI C E Balaguruswami, (BPB Publications, New Delhi, INDIA)..
2. Teach Yourself C Charles Siegel, (BPB Publication, New Delhi, INDIA)
3. The Spirit of C Henry Mullish and Herbert L. Cooper, (Jaico Publishing House, New Delhi, INDIA)



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Master of Science Electronics and Communication Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2S02NCELC04	Practicals	0-8-1	120	04

•Course Learning Outcomes (CLOs) On completion of this course, students will be able to:

- CLO1: Design and simulate digital circuits, predict expected outputs, implement in hardware, and analyze performance by comparing experimental results with theoretical and simulated outcomes.
- CLO2: Write, simulate, and debug C compiler assembly language programs, predict functional behavior, implement interfacing tasks, and validate results through execution and analysis.
- CLO3: Perform experiments to measure semiconductor device characteristics, predict behavior using theory and analyze results to extract parameters and explain deviations.
- CLO4: Explain working principles, predict instrument response, perform experiments using analytical and measuring instruments, and evaluate performance through observed results.
- CLO5: Engage in pre-lab design and simulation, implement systems systematically, and ensure safe, ethical, and environmentally responsible laboratory practices.
- CLO6: Critically analyze experimental data by comparing hardware, simulation, and theoretical results, explain discrepancies, and communicate findings through structured technical reports.

Unit	List of Suggested Practicals	Learning Pedagogies*	CLO(s)
I-IV	Experiments based on Communication, subject Code P2S02NCELC01: Analog and Digital Communication & Experiments based on C Language subject Code P2S02NCELC02: C Language and C++	Classroom Lecture (CL), Seminars (Student-led and Faculty-moderated), Inquiry-Based Learning	CLO1, CLO6

• Assessment Methodologies

(A) Internal Assessment

a. Internal Formative assessment

- Performance of Experiment and Execution
- Writing of Laboratory Journal and Technical Documentation
- Viva Voce Assessment

b. Internal Summative Assessment

(a) Mid-term test



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(B) Weightage of Learning Efforts for External Assessment

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1 - CLO6	120	10	10	30	50
		120	10	10	30	50

• Assessment and Evaluation

Sr.No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	• Experimental Performance and Execution • Results Reporting and Technical Documentation • Viva Voce Assessment • Laboratory Conduct and Practices • Regularity and Active Participation • Group Discussion and Collaborative Learning	50%
2	End-Semester Examination	Experimental Performance, Analysis, Reporting of Readings, and Conceptual Understanding	50%

Suggested Learning Materials:

- Lab Manuals
- Textbooks of respective course
- Simulation Tools
- Virtual Lab/NPTEL videos with facility for projection
- Hardware Setup
- Computer and Printer Set up for documentation and graphs



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Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2S01NCELC05	Project	0-8-1	120	04

•Course Learning Outcomes (CLOs) On completion of this course, students will be able to:

- CLO1: Design and simulate digital circuits, predict expected outputs, implement in hardware, and analyze performance by comparing experimental results with theoretical and simulated outcomes.
- CLO2: Write, simulate, and debug microcontroller assembly language programs, predict functional behavior, implement interfacing tasks, and validate results through execution and analysis.
- CLO3: Perform experiments to measure semiconductor device characteristics, predict behavior using theory and analyze results to extract parameters and explain deviations.
- CLO4: Explain working principles, predict instrument response, perform experiments using analytical and measuring instruments, and evaluate performance through observed results.
- CLO5: Engage in pre-lab design and simulation, implement systems systematically, and ensure safe, ethical, and environmentally responsible laboratory practices.
- CLO6: Critically analyze experimental data by comparing hardware, simulation, and theoretical results, explain discrepancies, and communicate findings through structured technical reports.

Unit	List of Suggested Practical's	Learning Pedagogies*	CLO(s)
I-IV	Experiments based on 8051 Microcontroller, subject Code P2S01NCELC03: 8 Bit Microcontroller and Applications	Classroom Lecture (CL), Seminars (Student-led and Faculty-moderated), Inquiry-Based Learning	CLO1-CLO6

• Assessment Methodologies

(C) Internal Assessment

a. Internal Formative assessment

- Performance of Experiment and Execution
- Writing of Laboratory Journal and Technical Documentation
- Viva Voce Assessment

b. Internal Summative Assessment

- (a) Mid-term test



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(D) Weightage of Learning Efforts for External Assessment

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1 - CLO6	120	10	10	30	50
		120	10	10	30	50

• Assessment and Evaluation

Sr.No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	• Experimental Performance and Execution • Results Reporting and Technical Documentation • Viva Voce Assessment • Laboratory Conduct and Practices • Regularity and Active Participation • Group Discussion and Collaborative Learning	50%
2	End-Semester Examination	Experimental Performance, Analysis, Reporting of Readings, and Conceptual Understanding	50%

Suggested Learning Materials:

- Lab Manuals
- Textbooks of respective course
- Simulation Tools
- Virtual Lab/NPTEL videos with facility for projection
- Hardware Setup
- Computer and Printer Set up for documentation and graphs



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Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
SKILL	P2S02NSELC01	Advanced Electronic Devices, Microwave and Quantum Systems with IKS Perspectives	3-0-1	120	04

- **Course Learning Outcomes (CLOs)** On completion of this course, students will be able to:

CLO 1:.	Analyze semiconductor devices using carrier transport theories and relate them to fundamental concepts of matter, including Kanada's atomic theory
CLO 2:.	Evaluate microwave and high-frequency devices (IMPATT, TRAPATT, BARITT) and analyze their operation in microwave generation, amplification, and communication systems.
CLO 3:.	Explain superconductivity and analyze superconducting devices such as Josephson junctions, SQUIDS, and their applications in advanced systems.
CLO 4:.	Analyze magnetic materials and devices, including ferromagnetic and ferrimagnetic systems, and evaluate their role in electronic applications such as memory, sensors, and MRI.
CLO 5:.	Interpret quantum phenomena including quantum size effects, entanglement (EPR), observer effect, and qubits in the context of modern electronic and nanoscale systems.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Semiconductor Physics and Foundational Concepts- Carrier transport and scattering mechanisms, High-field effects and breakdown, Boltzmann transport equation, Advanced MOSFETs and scaling	CL, Seminars, Inquiry-Based Learning	CLO1
II	Microwave and High-Frequency Devices and Systems-Microwave frequency characteristics, Transit-time devices: IMPATT diode, TRAPATT diode, BARITT diode, Negative resistance and oscillations, Microwave generation and amplification, Microwave systems: radar and communication	CL, PBL, ICT-Enabled Learning	CLO2
III	Magnetic Properties and Devices - Ferromagnetism and Ferrimagnetism, Magnetic domains and hysteresis, Magnetic materials and devices (memory, sensors, cores), MRI as a quantum-magnetic system Superconductivity and Superconducting Devices - Superconductivity fundamentals (Meissner effect, zero resistance), Type I and Type II superconductors, BCS theory (introductory)	CL, ICT-enabled learning,	CLO3&4



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IV	Quantum and Nanoscale Effects - Quantum size effect, Introduction to nanostructures Quantum Physics Concepts in Electronics- Einstein-Podolsky-Rosen paradox and quantum entanglement, Observer effect in measurement systems, Introduction to qubits and quantum information- Concept of qubit vs classical bit- Superposition and quantum states- Physical realization (overview): Superconducting qubits, Spin-based qubits,	CL, Seminars, CBL, Mini Projects	CLO5
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• Assessment Methodologies

(J) Internal Assessment

a. Internal Formative assessment

- (j) MCQ and Objective question Quiz
- (k) Seminar/Presentation and Group Discussion
- (l) Assignments

b. Internal Summative Assessment

- (a) Mid-term tests

(K) Weightage of Learning Efforts for External Assessment

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1, CLO2	30	3	3	8	14
II	CLO3	30	3	3	8	14
III	CLO4	30	2	2	7	11
IV	CLO5	30	2	2	7	11
		120	10	10	30	50

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Mid Term Test, Class Regularity, Group Discussion	50
2	End-Semester Examination	Written Exam	50



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(L) CLOs – PLOs Matrix

CLO	PLO										
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
CLO1	3	2	–	1	–	1	1	–	1	–	2
CLO2	3	2	–	1	1	2	1	–	–	–	1
CLO3	3	3	–	2	1	2	2	–	–	–	1
CLO4	2	1	–	3	2	2	2	1	–	1	2
CLO5	1	3	1	1	–	1	3	1	2	1	2
CLO6	2	3	2	1	–	1	3	2	2	2	3

Values to CLO-PLO matrix are assigned by **judging the importance of the particular CLO** in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

• Suggested Learning Materials Books:

1. Physics of Semiconductor Devices, S. M. Sze, Yiming Li, Kwok K. Ng, John Wiley & Sons.
2. Semiconductor Devices Physics and Technology, S. M. Sze, Ming- Kwei Lee, John Wiley & Sons.
3. Microwave Devices and Circuits, Samuel Y. Liao, Pearson Education.
4. Quantum Computation and Quantum Information, Michael A. Nielsen, Isaac L. Chuang, Cambridge University Press.
5. Solid State Electronic Devices, Streetman, B. G., & Banerjee, S., Pearson Education.