Detailed Curriculum for Undergraduate Degree
B.Tech in Electronics and Communications Engineering
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum of 3rd semester

Course Name:	**Electronic Devices**		
Course Code:	PC-EC301	**Category:**	Professional Core
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To impart basic concepts of semiconductor physics.
2	To impart knowledge of p n junction and different diodes.
3	To impart knowledge of BJT and MOSFET.
4	To impart knowledge about characteristics of diodes and transistors
5	To develop an insight into the construction and working of opto electronic devices

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	**Energy Bands & Current Carriers in Semiconductors:** Introduction-Energy Band Theory. Elemental and Compound Semiconductors, Direct and Indirect bandgap semiconductors, Fermi-Level, Intrinsic and Extrinsic Semiconductors, Effective mass, Concept of Holes, Carrier Concentration. and Mobility, diffusion and drift of charge carriers, Generation and recombination of carriers; continuity equation. Quasi Fermi Energy level, Degenerate and Non-Degenerate semiconductors, Hall effect	10L
2.	**P-N junction:** P-N junction physics, I-V characteristics, junction capacitance, Avalanche breakdown, Zener diode, Zener breakdown, ohmic contacts, Schottky diode, Tunnel Diode, Gunn diode, IMPATT Diode, Varactor diode. Basic device technologies for fabrication of a p-n	10L

3.	junction, **Bipolar Junction Transistor**: Basic Construction, I-V characteristics, Ebers-Moll Model. **FET**: JFET-Basic construction, principle of operation, Drain and Transfer characteristics. MOSFET- Basic construction, Depletion and Enhancement type, I-V characteristics, FET parameters, MOS capacitor, C-V characteristics, flat band voltage and threshold voltage and small signal models of MOS transistor	8L
4.	**Opto–Electronics**: Optical absorption in semiconductors, photovoltaic effects, solar cells (p-n junction), Photoconductors, Photodiode, PIN photodiode, Avalanche photodiode, Phototransistor, LED, Semiconductor Laser (p-n junction) Integrated circuit: fabrication process.	8L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe semiconductor physics, semiconductor types and carrier transport phenomena
2	Describe working principle of various diodes, BJT, MOSFET, solar cell and opto electronic devices
3	Characterize diodes, BJT and MOSFETs
4	Calculate various device related parameters.

Learning Resources:	
1	Neamen- Semiconductor Physics and Devices TMH
2	Streetman Banerjee-Solid State Devices-PHI
3	Boylestad & Nashelsky- Electronics Devices and Circuit Theory- Pearson
4	Milman & Halkias - Electronics Devices and Circuits- TMH
5	Bhattacharya & Sharma- Solid State Electronic Devices- Oxford

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Semiconductor Devices	Dr. G.S. Visweswaran	IIT Delhi

	Course Link: https://nptel.ac.in/courses/117102061

Course Name:	**Analog Electronic Circuits**		
Course Code:	PC-EC302	**Category:**	Professional Core
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electrical & Electronics ES-EE 101
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To impart basic concept of diode circuits and transistor biasing.
2	To impart knowledge about low frequency and high frequency transistor models, using such models for estimation of transistor performance parameters.
3	To understand the different feedback topologies and amplifier classes.
4	To understand the basic principle of operation of various oscillators.
5	To develop an insight into the construction and working of OPAMPS and its applications.
6	To explain design aspects of simple circuits.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Diode Circuits and BJT Amplifier**: Rectifiers & Filters, Clipper, Clamper. Biasing schemes for BJT amplifiers, bias stability, small signal analysis (h-parameter analysis of CE and CC configurations), low frequency transistor models, estimation of voltage gain and current gain, input impedance, output impedance, design procedure of CE amplifier for particular specifications, Darlington Pair. High frequency transistor models, frequency response of single stage amplifiers, CE Short Circuit current gain, Concept of Gain &	10L

	bandwidth product. Multi Stage Amplifier - RC Coupled, Transformer Coupled and direct coupled, Frequency response - effect of coupling and bypass capacitor. Current source biasing (Current mirror circuits: Widler current source, Wilson current source etc.).	
2	**MOSFET Amplifier:** Biasing scheme of MOSFET Amplifiers, CS/CD configurations and their analysis	4L
3	**Amplifier Models and Feedback Topologies:** Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth, I/P & O/P impedance, Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans resistance amplifier.	6L
4	**OPAMP**: Basic structure and characteristics, Differential amplifier: Basic structure and principle of operation, frequency response of OPAMP, Application of Current Mirror biasing in OPAMP, Output Stage, Single pole model. Open-loop configurations. OP-AMP applications: Inverting and non-inverting amplifiers, Integrator and differentiator, summing amplifier, Log-Antilog amplifiers, Comparator, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop. Instrumentation amplifier, precision rectifier.	10L
5	**Oscillators & Power Amplifiers**: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), Multivibrators (Monostable, Astable and Bistable), Study on 555 timer ICs. Various classes of operation (Class A, B, AB, C etc.), Harmonic distortion, Power Output, Push-Pull Amplifier, Complementary Symmetry circuits.	10L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the operation of simple circuits with transistor, op-amp, amplifiers, oscillators.
2	Design of simple circuits with op-amp, amplifiers and oscillators.

3	Solve simple design based problems related to circuits using diodes, transistors and OPAMPS.
4	Analyze simple circuits with transistor and op-amps.

Learning Resources:	
1	Boylestade & Nashelsky- Electronic Devices and Circuit Theory- Pearson/PHI
2	Millman & Halkias - Electronics Devices and Circuits- TMH
3	Sedra & Smith-Microelectronic Circuits- Oxford UP
4	Malvino—Electronic Principles , 6/e , McGraw Hill
5	Franco—Design with Operational Amplifiers & Analog Integrated Circuits , 3/e, McGraw Hill
6	Schilling & Belove—Electronic Circuit:Discrete & Integrated , 3/e , McGraw Hi

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Analog Electronic Circuits	Prof. Shanthi Pavan	IIT Madras
	Course Link: https://nptel.ac.in/courses/108106188		
2	Analog Electronic Circuits	Prof. Shouribrata Chatterjee	IIT Delhi
	Course Link: https://nptel.ac.in/courses/108102112		
3	**Analog Circuits**	Prof. Jayanta Mukherjee	IIT Bombay
	Course Link: https://nptel.ac.in/courses/108101094		
4	**Analog Electronic Circuits**	Prof. Pradip Mandal	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/108105158		
5	**Analog Circuits**	Prof. Nagendra Krishnapura	IIT Madras
	Course Link: https://nptel.ac.in/courses/108106084		

Course Name:	**Signals and Systems**		
Course Code:	PC-EC303	**Category:**	Professional Core
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Engineering Mathematics, Fundamentals of Electrical Circuits
Full Marks:	100		
Examination Scheme:	Semester Examination:70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To develop a clear understanding of fundamental concepts and mathematical modeling of signals and systems.
2	To apply mathematical transformation techniques such as Fourier and Laplace transforms to solve Electronics Engineering problems.
3	To utilize modern computational and simulation tools for effective analysis and visualization of signals and systems.
4	To analyze the behavior of continuous-time and discrete-time systems in time and frequency domains for practical engineering applications.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to signal:** Standard Continuous Time Signals, Classification of Continuous Time Signals (Periodic and Nonperiodic Signals, Symmetric and Antisymmetric Signals, Energy and Power Signals, Causal, Noncausal and Anti-causal Signals), Mathematical Operations on Continuous Time Signals (Scaling, Folding, Time Shifting, Addition, Multiplication, Differentiation and Integration), Properties of Impulse Signal.	6L
2	**Introduction to System:** Overview of System, Classification of Continuous Time Systems (Static and Dynamic, Time Invariant and Time Variant, Linear and Non-linear, Causal and Noncausal, Stable and Unstable), LTI System, Linear and Circular Convolution, Properties of Convolution, Unit Step Response using Convolution, Inverse System, Interconnections of Continuous Time Systems.	6L
3	**Laplace Transform:** Introduction to Laplace Transform, Region of Convergence (ROC), Properties of Laplace Transform, Initial and Final value Theorem, Convolution Theorem using Laplace Transform, Representation of Poles and Zeros in 'S' Plane, Inverse Laplace Transform by Partial Fraction Expansion Method, Inverse Laplace Transform using Convolution Theorem, Convolution and De-convolution using Laplace Transform and Inverse Laplace Transform.	6L
4	**Fourier Series:** Introduction to Fourier Series, Conditions for Existence of Fourier Series, Properties of Fourier Series, Gibbs Phenomenon, Trigonometric Form of Fourier Series, Exponential Form of Fourier Series.	6L
5	**Fourier Transform:** Introduction to Fourier Transform, Properties of Fourier Transform, Relation Between Fourier and Laplace Transform, Discrete time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), Overview of FFT algorithm, Parseval's Theorem, Analysis of LTI Continuous Time System Using Fourier Transform.	6L

6	**Sampling Theorem:** Representation of Continuous Time Signals by its Samples, Sampling theorem (Nyquist Sampling Criterion), Concept of Sampling in Time Domain, Aliasing Effect, Frequency Domain Analysis of Sampled Signals.	4L
7	**Z-Transforms**: Introduction to Z- Transformation, Properties of Z-transform, Relationship between Z- transform and Fourier Transform, Region of Convergence (ROC), Representation of Poles and Zeros in z-plane, Inverse Z-Transform, Analysis of LTI Discrete Time System Using Z-Transform, Convolution and Deconvolution Using Z-Transform, Structure realization of LTI discrete Time Systems in Z-Domain.	6L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Classify and analyze various types of continuous-time and discrete-time signals.
2	Model and represent systems in time and frequency domains using appropriate mathematical transforms.
3	Evaluate system properties such as stability, causality, and linearity for engineering applications.
4	Apply sampling principles and signal reconstruction techniques for accurate signal processing.

Learning Resources:	
1	A.Nagoor Kani- Signals and Systems- McGraw Hill
2	P.Ramesh Babu & R.Anandanatarajan- Signals and Systems 4/e- Scitech
3	A.V.Oppenheim, A.S.Willsky and S.H.Nawab -Signals & Systems, Pearson
4	S.Haykin & B.V.Veen, Signals and Systems- John Wiley
5	V. Krishnaveni and A. Rajeswari -Signals and Systems, Wiley

Course Name:	**Network Theory**		
Course Code:	PC-EC304	**Category:**	Professional Core
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Engineering Mathematics, Basic Electrical and Electronics Engineering.
Full Marks:	100		
Examination Scheme:	Semester Examination:70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To develop a strong foundation in the analysis of DC and AC electrical networks using fundamental laws and principles.
2	To apply various network theorems and systematic methods for solving complex electrical circuits.
3	To understand and transform two-port network parameters for modeling interconnected systems.
4	To analyze transient and steady-state responses of RC, RL, and RLC circuits.
5	To design and synthesize passive filter networks and driving-point functions for practical applications.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Basic Circuit Analysis and Network Topology:** Basic circuit Elements, Independent and Dependent Voltage & Current Sources, Series, Parallel, Star and Delta Connections, Mesh and Node analysis, Ohm's Law, KCL and KVL analysis, Super node Analysis.	6L
2	**Network Theorems for DC and AC Circuits:** Network reduction Techniques, Voltage and Current Division Rules, Thevenin's, Norton's, Superposition, Millman's, Maximum Power Transfer Theorem, Reciprocity and Tallegen's Theorem.	6L
3	**AC Circuits, Resonance and Coupled Circuits:** Voltage-Current Relation of R, L and C in Various Domains, Resonance Frequency of Series RLC Circuit, Q-Factor (Quality Factor), Bandwidth and Selectivity of Series RLC Circuit, Resonant Frequency of Parallel RLC Circuits, Coupled Circuits (Self-Inductance and Mutual Inductance).	8L
4	**Transient Analysis:** Introduction to Transient Response (Natural and Forced Response), Transient Analysis Using Laplace Transform, Transient Response of RL Circuit, Transient Response of RC Circuit, Transient Response of RLC Circuit (Initial and Final Conditions in RLC Circuit), Complete Response of Circuits Excited by Sinusoidal Source.	8L
5	**Two-Port Networks:** Introduction to Two Port Network, Parameters of a Two-Port Network, Impedance Parameters (or Z-Parameters), Admittance Parameters (or Y-Parameters), Transmission Parameters (or ABCD-Parameters), Hybrid Parameters (or h-Parameters), Properties of Two-Port Networks, Inter-Connection of Two-Port Networks, T and π Networks.	8L
6	**Graph Theory:** Basic Network Terminology of graph theory (Trees, Link, Twig and Cotree), Network Analysis using Incidence Matrix, Node Analysis Using Cut-Set Matrix, Mesh Analysis Using Tie-Set Matrix, Duality of Network.	4L
Total		**40L**

Course Outcomes:

After completion of the course, students will be able to:	
1	**Apply fundamental circuit laws and analytical techniques** such as mesh, nodal, and topology-based methods to analyze DC and AC electrical networks.
2	**Utilize network theorems and reduction techniques** to simplify and solve complex electrical circuits efficiently.
3	**Analyze steady-state and transient behaviour of RLC circuits**, including resonance characteristics using Laplace transform methods.
4	**Model and evaluate two-port networks and graph-theoretic representations** for systematic analysis of interconnected electrical systems.

Learning Resources:	
1	M. E. Van Valkenburg, *Network Analysis*, Prentice Hall of India (PHI).
2	J. A. Edminister, *Theory and Problems of Electric Circuits*, McGraw-Hill Company.
3	Sudhakar: —Circuits & Networks: Analysis & Synthesis 2/e TMH
4	Ravish R. Singh - Circuit Theory and Networks Analysis and Synthesis-McGraw-Hill
5	A. Nagoor Kani - Circuit Analysis-McGraw-Hill Education

Course Name:	**Data Structure and Algorithm**		
Course Code:	PC-EC305	**Category:**	Professional Core
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Programming for Problem Solving
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To impart basic concepts of data structures and algorithms.
2	To understand the concepts of searching and sorting techniques.
3	To understand basic concepts of stack, queue, list, tree and graph.
4	To develop capability of writing algorithm to solve a given problem with the help of fundamental data structures.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Introduction: Basic Terminologies, Elementary Data Organizations Data Structure Operations: insertion, deletion, traversal etc. and	6L

	application of these on arrays. Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.	
2	Stack and its operations: Algorithms and their complexity analysis. Applications of Stacks: Evaluation of arithmetic expressions. Queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their complexity analysis.	8L
3	Linked List: Singly, Doubly and Circular linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list. Linked representation of Stack and Queue.	8L
4	Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Header nodes. Binary Search Tree, AVL Tree, Operations on each of the Trees, Application of Binary Trees, B Tree, B+ Tree: definitions, algorithms and analysis.	12L
5	Sorting: Objective and properties of different sorting algorithms and their complexity analysis: Bubble sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort.	6L
6	Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis, Shortest path algorithms. Hashing: Objective, Different methods of hashing, Collision: Different collision resolution methods, Application of hashing.	8L
Total		**48L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Analyze an algorithm to determine its computational complexity.
2	Understand the concept of data storing and retrieval using array and linked list and compare their relative advantages and disadvantages.
3	Apply appropriate technique to solve a given sorting or searching problem.
4	Understand the concept of stack and queue and apply it to solve complex engineering problems.
5	Understand the concept of tree and apply it to solve engineering problems.

6	Understand the concept of graph and apply it to solve real life problems.

Learning Resources:	
1	Data Structure Using C, Reema Thereja, Oxford University Press, 2nd Edition, 2014
2	Data Structure using C++, A. Tanenbaum, Pearson, 2nd Edition, 2015
3	Data Structure through C, Seymour Lipschutz, Schaum's Outline Series, McGraw Hill, 2017
4	Data Structure and Program Design in C, R. L. Kruse, B. P. Leung, C. L. Tondo, Prentice Hall of India, 1st Edition, 1990
5	Data Structure through C language, Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, BPB Publications, 2010
6	Data Structures & Algorithms using C, R.S. Salaria, Khanna Publishing House, New Delhi, 5th Edition, 2018

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Data Structures And Algorithms	Prof. Naveen Garg	IIT Delhi
	Course Link: https://nptel.ac.in/courses/106102064		
2	Data Structures and Algorithms Design	Prof. Nitin Saxena	IIT Kanpur
	Course Link: https://nptel.ac.in/courses/106104697		

Course Name:	**Numerical Techniques**		
Course Code:	ES-EC301	**Category**	Engineering Science Course
Semester:	3rd	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	Some concepts from basic math algebra, geometry, pre-calculus
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To understand sources of numerical errors and analyze their effect on computational accuracy.
2	To apply numerical techniques to solve systems of linear and non-linear equations.

3	To develop the ability to apply finite difference calculus, interpolation techniques, and curve fitting methods for numerical approximation of discrete data.
4	To enable the application of numerical integration techniques and numerical methods for solving ordinary differential equations in engineering applications.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Approximation in Numerical Computation:** Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors.	3L
2	**Numerical Solution of a System of Linear Equations:** Gauss Elimination Method, Gauss-Seidel Iterative Method, LU Factorization Method.	4L
3	**Numerical Solution of Non-Linear Equation:** Bisection Method, Regula-Falsi Method, Newton-Raphson Method	3L
4	**Finite Differences and Interpolation Techniques:** Introduction to finite difference calculus, forward, backward and central differences, Divided differences, Newton's Forward and Backward interpolation, Lagrange's interpolation, Newton's divided difference interpolation.	5L
5	**Curve Fitting by Method of Least Square:** Fitting a straight line of the form $y = a + bx$, Fitting a curve of the form $y = ax + bx^2$, $y = ab^x$, $y = ae^{bx}$, $y = ax^b$.	2L
6	**Numerical Integrations:** General quadrature formula, Trapezoidal rule, Simpson's 1/3 rule.	3L
7	Numerical Solution of Ordinary Differential Equations: Euler's method, Runge-Kutta method of order four, Predictor-Corrector methods, Finite difference method	4L
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Analyze truncation and rounding errors and assess numerical accuracy in computational problems.
2	Apply numerical methods to solve non-linear equations and system of linear equations.
3	Apply finite difference calculus, interpolation techniques, and curve fitting methods to obtain numerical approximations from discrete data.
4	Solve definite integrals and ordinary differential equations using numerical methods with error estimation.

Learning Resources:	
1	"C Language and Numerical Methods" by C. Xavier, New Age International Publishers.
2	"Numerical Methods-A Programming Based Approach" by A. K. Jalan and Utpal Sarkar, Orient Blackswan Private Ltd.
3	"Numerical Methods (Problems and Solution)" by Jain, Iyengar, & Jain, New Age International Publishers.
4	"Numerical Methods" by Balagurusamy, Scitech.
5	"Numerical Methods" by Baburam, Pearson Education.
6	"Computer Programming & Numerical Analysis" by N. Dutta, Universities Press.
7	"Numerical Methods" by Soumen Guha & Rajesh Srivastava, Oxford University Press.
8	"Numerical Methods" by Srimanta Pal, Oxford University Press.

Alternative NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Numerical Analysis	Prof. S. Baskar	IIT Bombay
2	Numerical Methods for Engineers	Prof. Niket Kaisare	IIT Madras
3	Numerical Methods	Prof. Ameeya Kumar Nayak & Prof. Sanjeev Kumar	IIT Roorkee

Course Name:	**Environmental Science**		
Course Code:	AU-BS371	**Category:**	Basic Science Courses
Semester:	Third	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	Class XII Physical & Bio Science
Full Marks:	100		
Examination Scheme:	Teacher Assessment: 70 (30 + 40)	Participation in Events: 15	Attendance: 15

Course Objectives:	
1	To solve various engineering problems applying ecosystem to produce eco-friendly products.
2	To use relevant air, noise, water and soil control method to solve domestic and industrial problems.
3	To recognize relevant energy sources required for domestic and industrial applications.
4	To solve local solid and e-waste problems.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**

1	**Ecosystem:** Structure of ecosystem, Food chain and food web, Aquatic and terrestrial ecosystem, Carbon, Nitrogen, Sulphur and Phosphorous cycle, Depletion of ozone.	2L
2	**Environmental Degradation:** Air Pollution: Natural and manmade sources of air pollution, Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator) Noise Pollution: Sources and effects of pollution, measurement of pollution level, Noise pollution Rules-2000 Water Pollution: Types of water pollutants, BOD and COD, Waste Water Treatment (Primary, Secondary and Tertiary methods). Soil Pollution: Causes, Effects and Preventive measures of soil pollution, E- waste, Plastic waste	7L

3	**Renewable sources of Energy:** Solar Energy: Basics of Solar energy, Solar Pond, Solar water heater, solar dryer, Solar stills. Biomass: Biogas production mechanism, Utilization and storage of biogas. Wind Energy: Current status and future prospects of wind energy. New Energy sources: Hydrogen energy, Ocean energy resources, Tidal energy conversion.	7L
4	**Solid Waste Management, ISO 14000 & Environmental Management:** Solid waste: Municipal solid waste, Biomedical waste, Metallic and Non-metallic wastes, Hazardous waste, Collection and disposal of municipal solid waste, Waste to wealth Concept of carbon footprint Environmental management in fabrication industry ISO14000: Implementation in industries, Benefits.	8L
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco-friendly products.
2	Analyse the air, water, soil and noise pollution, and control measures and acts.
3	Understand different renewable energy resources and efficient process of harvesting.
4	Understand solid waste management, ISO 14000 & Environmental Management.

Learning Resources:	
1	"Fundamentals of Environment and Ecology" by D. De & D. De, S Chand Publication
2	"Text Book of Environmental Studies" by E. Bharucha, Byju's
3	"Environmental Studies" by S. C. Sharma and M. P. Poonia, Khanna Book Publishing
4	"Environmental Studies" by M. Basu, Cambridge University Press
5	"Fundamentals of renewable energy processes" by A. Vieira & D. Rosa, Academic Press Inc
6	"Principles Solar Engineering" by F. Kreith and J. F. Kreider, CRC Press.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
	Environmental Science	Prof. Shamik Chowdhury, Prof. Sudha Goel	IIT Kharagpur

1	**Course Link: https://nptel.ac.in/courses/109105203**		
2	Introduction to Environmental Engineering and Science - Fundamental and Sustainability Concepts	Prof. Brajesh K Dubey	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/127105018		

Course Name:	**Electronic Devices laboratory**		
Course Code:	PC-EC391	**Category:**	Professional Core
Semester:	Third	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Electronics Engineering Lab
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 40	Attendance: 00

Course Objectives:	
1	To impart basic concept of constructing circuits on breadboard with diodes, BJT, LDR and SCR.
2	To impart knowledge about CE amplifier design.
3	To impart knowledge as how to perform the experiments in sequential steps for characterizing the devices.
4	To impart knowledge as how to determine various device parameters and amplifier bandwidths.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1.	Study of line and load regulation of a Zener Diode.	2
2.	Study characteristics of LED & LDR.	2
3.	Common Emitter Bipolar Junction Transistor Characteristics: To plot the Input and Output characteristics of a transistor connected in Common Emitter Configuration and to find the h–parameters from the characteristics.	4
4.	MOSFET Drain & Transfer characteristics (common source): To plot Drain and Transfer characteristics. To find r_d, g_m, and μ from the characteristics.	4

5.	Study characteristics of Photo transistor.	2
6.	CE Amplifier Design, study of frequency response and determination of bandwidth.	4
7.	Study of frequency response of a JFET common source amplifier and determination of bandwidth.	2
8.	Resistive triggering of SCR.	4
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Construct electronic circits on bread board.
2	Characterize BJT, MOSFET, LED. LDR
3	Experimentally determine device parameters
4	Design amplifier circuits, implement them practically & determine bandwidth from graph.

Learning Resources:	
1	Boylestade & Nashelsky- Electronic Devices and Circuit Theory- Pearson/PHI
2	Millman & Halkias - Electronics Devices and Circuits- TMH
3	Sedra & Smith-Microelectronic Circuits- Oxford UP
4	Malvino—Electronic Principles , 6/e , McGraw Hill
5	Laboratory Manual

Course Name:	**Analog Electronic Circuits Laboratory**		
Course Code:	PC-EC392	**Category:**	Professional Core
Semester:	Third	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Electrical & Electronics lab ES-EE191
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To impart concept of constructing circuits on breadboard with diodes, BJT and OPAMPs
2	To impart knowledge about amplifier and oscillator design.

3	To impart practical knowledge on OPAMP characteristics and application.
4	To be able to perform the experiments in sequential steps for determining various circuit parameters.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Conduct experiment to test diode clipping (single/double ended) and clamping circuits (positive/negative).	2
2	Design and set up the following rectifiers with and without filters and to determine ripple factor and rectifier efficiency: (a) Center Tap Full wave Rectifier (b) Bridge Rectifier	4
3	Study of Zener Regulator	2
4	Design a two-stage R-C coupled amplifier & determine of it's gain & Bandwidth.	4
5	Study the working of a class A and class B amplifier and calculate the efficiency.	2
6	Study of OPAMP741and industrial OPAMP: characteristics-input bias current, input offset current, output offset voltage, offset null, CMRR, Slew Rate.	4
7	Study on OPAMP applications - summing amplifier, subtractor, active first order low pass and high pass filter.	6
8	Design a Wien Bridge Oscillator and determine the frequency of oscillation.	2
Total		**26**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain application and demonstrate diode as a clipper, clamper and regulator.
2	Experimentally determine efficiency and ripple factor of rectifiers.
3	Design amplifier and oscillator circuits, implement them practically & determine parameters from graph or calculation.
4	Characterize practical OPAMP and apply it to operational and filter circuits

Learning Resources:	
1	Boylestade & Nashelsky- Electronic Devices and Circuit Theory- Pearson/PHI
2	Millman & Halkias - Electronics Devices and Circuits- TMH
3	Sedra & Smith-Microelectronic Circuits- Oxford UP

4	Malvino—Electronic Principles , 6/e , McGraw Hill
5	Franco—Design with Operational Amplifiers & Analog Integrated Circuits , 3/e, McGraw Hill
6	Schilling & Belove—Electronic Circuit: Discrete & Integrated , 3/e , McGraw Hill
7	Handbook of Analog Circuit Design Paperback .

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Analog Electronic Circuits	Prof. Shanthi Pavan	IIT Madras
	Course Link: https://nptel.ac.in/courses/108106188		
2	Analog Electronic Circuits	Prof. Shouribrata Chatterjee	IIT Delhi
	Course Link: https://nptel.ac.in/courses/108102112		
3	**Analog Circuits**	Prof. Jayanta Mukherjee	IIT Bombay
	Course Link: https://nptel.ac.in/courses/108101094		
4	**Analog Electronic Circuits**	Prof. Pradip Mandal	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/108105158		
5	**Analog Circuits**	Prof. Nagendra Krishnapura	IIT Madras
	Course Link: https://nptel.ac.in/courses/108106084		

Course Name:	**Network Theory Laboratory**		
Course Code:	PC-EC394	**Category:**	Professional Core
Semester:	Third	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Electrical & Electronics Engineering, Analog Circuit Fundamentals, Engineering Mathematics.
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To understand and analyze basic DC and AC circuits using passive and active components through practical implementation.
2	To apply network theorems and two-port network parameters for systematic analysis and design of electrical networks.
3	To design, construct, and test circuits on breadboards and simulation platforms using modern simulation tools.
4	To measure and evaluate electrical quantities including voltage, current, power, and

	three-phase parameters for real-world applications.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using Simulation Tool.	2
2	a) Verification of KCL & KVL for any network. b) Apply Mesh & Nodal Analysis techniques for solving electrical circuits.	2
3	Verification of Network theorems (Thevenin's, Norton and Superposition) using software/ hardware with AC & DC source.	2
4	Determination of Laplace transform and Inverse Laplace transform using Simulation Tool.	2
5	Determination of Impedance (Z) and Admittance (Y) parameter of two- port network: simulation/ hardware.	2
6	Transient response of R-L and R-C network: simulation with software/ hardware.	2
7	Transient response of R-L-C series and parallel circuit: simulation with software/hardware.	2
8	Design and Determine the Frequency response of LP and HP filters: simulation & hardware.	2
9	Design and Determine the Frequency response of BP and BR filters: simulation/ hardware.	2
Total		**18**

Course Outcomes:	
After completion of the course, students will be able to:	
1	**Generate and analyze different electrical signals** using Simulation Tool and laboratory instruments for circuit studies.
2	**Apply circuit analysis techniques and network theorems** (KCL, KVL, mesh, nodal, Thevenin, Norton, and superposition) to solve practical AC and DC networks.
3	**Determine system parameters and transient responses** of R, L, and C circuits using simulation tools and hardware implementation.
4.	**Design and evaluate frequency response of basic filters and two-port networks** through software simulation and experimental verification.

Learning Resources:	
1	Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers by Rudra Pratap (Author)
2	Getting Started with MATLAB 7 by Rudra Pratap
3	Spice Circuits Electronics Pspice Paperback – Import, 1 October 1989 by M.H. Rashid
4	Lab Manual

Course Name:	**Data Structure Laboratory**		
Course Code:	PC-EC395	**Category:**	Professional Core
Semester:	Third	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Programming for Problem Solving Lab
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To impart basic concepts of data structures and algorithms.
2	To understand the concepts of searching and sorting techniques.
3	To understand basic concepts of stack, queue, list, tree and graph.
4	To develop capability of writing algorithm to solve a given problem with the help of fundamental data structures.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Insert, delete and display an array and find the maximum and minimum elements of it.	2
2	Representing sparse matrix in 3-tupple format.	2
3	Linear search and binary search using array.	2
4	Sorting elements of an array using bubble sort, selection sort, insertion sort, quick sort and merge sort algorithms.	2
5	Insert, delete and display elements of a singly linked list.	2
6	Insert, delete and display elements of a doubly linked list.	2
7	Implementing stack (push, pop and display operations) using linked list.	2
8	Convert infix to postfix expression using stack.	2
9	Evaluate postfix expression using stack.	2
10	Implementing linear queue using linked list	2
11	Implementing circular queue using array.	2
12	Creating Binary Search Tree and traverse it in in-order, pre-order and	2

	post-order fashion.	
13	Creating AVL Tree and traverse it in in-order, pre-order and post-order fashion.	2
14	Implementing Hash table incorporating collision resolution method.	2
Total		**28**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Implement menu driven application using array and matrix.
2	Implement different sorting and searching techniques using array.
3	Implement menu driven applications using linked list.
4	Apply the concept of stack and queue and apply it to solve engineering problems.
5	Create and traverse Binary Search Tree and AVL tree.
6	Generate Hash table using hash function incorporating collision resolution methods.

Learning Resources:	
1	Data Structure Using C, Reema Thereja, Oxford University Press, 2nd Edition, 2014
2	Data Structure using C++, A. Tanenbaum, Pearson, 2nd Edition, 2015
3	Data Structure through C, Seymour Lipschutz, Schaum's Outline Series, McGraw Hill, 2017
4	Data Structure and Program Design in C, R. L. Kruse, B. P. Leung, C. L. Tondo, Prentice Hall of India, 1st Edition, 1990
5	Data Structure through C language, Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, BPB Publications, 2010
6	Data Structures & Algorithms using C, R.S. Salaria, Khanna Publishing House, New Delhi, 5th Edition, 2018

Course Name:	**Numerical Techniques Laboratory**		
Course Code:	ES-EC391	**Category**	Engineering Science Course
Semester:	3rd	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Knowledge of C Programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment:35	Attendance: 05

Course Objectives:

1	To apply numerical algorithms through C programming to solve non-linear equations and system of linear equations.
2	To apply interpolation and curve fitting techniques using C programs to analyze discrete and experimental data.
3	To use numerical integration methods implemented in C to approximate definite integrals.
4	To solve ordinary differential equations using standard numerical methods through C programming and analyze the accuracy of the solutions.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Assignments on Numerical Solution of a System of Linear Equations:** Gauss Elimination Method, Gauss-Seidel Method.	4
2	**Assignments on Solution of Non-Linear Equations:** Bisection Method, Regula-Falsi Method, Newton-Raphson Method.	4
3	**Assignments on Interpolation:** Newton's Forward and Backward Interpolation, Lagrange's Interpolation.	6
4	**Curve Fitting by the Method of Least Squares:** Fitting a straight line of the form $y = a + bx$, Fitting a curve of the form $y = ae^{bx}$.	4
5	**Assignments on Numerical Integration:** Trapezoidal Rule, Simpson's 1/3 Rule.	2
6	**Assignments on Numerical Solutions of ODEs:** Euler's Method, Runge-Kutta Method of Order Four.	4
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Build and execute C programs to solve non-linear equations and system of linear equations using numerical methods.
2	Construct and apply C programs for interpolation and least squares curve fitting to estimate functional values from given data.
3	Apply numerical integration techniques using C programs to evaluate approximate values of definite integrals.
4	Develop C programs for solving 1st order ordinary differential equations using numerical methods.

Learning Resources:	
1	"C Language and Numerical Methods" by C. Xavier, New Age International Publishers.
2	"Numerical Methods-A Programming Based Approach" by A. K. Jalan and Utpal Sarkar, Orient Blackswan Private Ltd.
3	"Numerical Methods (Problems and Solution)" by Jain, Iyengar, & Jain, New Age International Publishers.
4	"Numerical Methods" by Balagurusamy, Scitech.
5	"Numerical Methods" by Baburam, Pearson Education.
6	"Computer Programming & Numerical Analysis" by N. Dutta, Universities Press.

7	"Numerical Methods" by Soumen Guha & Rajesh Srivastava, Oxford University Press.
8	"Numerical Methods" by Srimanta Pal, Oxford University Press.

Detailed Curriculum for Minor Degree under Department of Electronics and Communications Engineering (w.e.f. AY: 2025-26)

Part VII: Detailed Syllabus of 3rd semester for Minor Degree

A. Minor Degree in IoT

Course Name:	**Introduction to Internet of Things**		
Course Code:	MN-EC301A	**Category:**	Minor
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Networking Programming for Problem Solving
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the terminology, technology and its applications
2	To understand the function of Sensors : Backbone of IoT
3	To understand the concept of M2M (Machine to Machine) with necessary protocols
4	To learn the Python Scripting Language used in many IoT devices and applications.
5	To understand a comprehensive study of the interlinked challenges of securing IoT ecosystems and protecting user privacy

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	Introduction to Internet of Things: Definition and characteristics of IoT, Physical design of IoT- Things in IoT, IoT Protocols, Logical Design of IoT- IoT communication models, Iot Communication APIs, IoT enabled technologies-Wireless sensor networks, Cloud computing, Big Data Analytics, Communication protocols, Embedded systems, IoT levels and deployment templates	10L
2.	Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications Introduction of Different Types of Sensors such as Capacitive, Resistive, Pressure, Humidity etc.	6L

3.	IoT and M2M Introduction, M2M-Difference between IoT and M2M, SDN and NFV for IoT Software Defined Networking, Network Function Virtualization. Difference between SDN and NFV for IoT. Basics of IoT System Management with NETCONF.	6L
4.	Introduction to Python: Language features of Python, Data types, Data structures, Control of flow, functions, modules, packaging, data/time operations, classes.	8L
5.	Internet of Things Privacy: Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smart Approach. Data Aggregation for the IoT in Smart Cities, Security.	6L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the definition and usage of the term —Internet of Things in different contexts
2	Explain function of Sensors and relation with IoT
3	Differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack
4	Build and test a IoT system involving prototyping, programming and data analysis

Learning Resources:	
1	Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015.
2	IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, Pearson Education, 2017.
3	Internet of Things, K.G. Srinivasa, G.M. Siddesh, R.R. Hanumantha, CENGAGE Leaning India, 2018
4	Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2016.
5	Nitesh Dhanjani, Abusing the Internet of Things, Shroff Publisher/O'Reilly Publisher.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**

1	Introduction To Internet of Things	Prof. Sudip Misra	IIT Kharagpur
	Course Link: https://onlinecourses.nptel.ac.in/noc22_cs53/preview		

B. Minor Degree in VLSI Design and Technology

Course Name:	**Electronic Materials and Devices**		
Course Code:	MN-EC301B	**Category:**	Minor
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To impart basic concepts of semiconductor physics and electronic materials
2	To impart knowledge of p n junction and different diodes.
3	To impart knowledge of BJT and MOSFET.
4	To impart knowledge about characteristics of diodes and transistors
5	To develop an insight into the construction and working of opto electronic devices

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	**Brief introduction to Electronic Materials:** Metals, Insulators/Dielectric materials, Semiconductors - Elemental and Compound Semiconductors, Direct and Indirect bandgap semiconductors, Fermi-Level, Intrinsic and Extrinsic Semiconductors, Effective mass, Concept of Holes, Carrier Concentration. and Mobility, diffusion and drift of charge carriers, Degenerate and Non-Degenerate semiconductors, Hall effect, magnetic materials, optoelectronic materials, superconducting materials, organic electronic materials.	12L
2.	**P-N junction:** P-N junction physics, I-V characteristics, junction capacitance, Avalanche breakdown, Zener diode, Zener breakdown, ohmic contacts, Schottky diode, Tunnel Diode, Gunn diode, IMPATT Diode.	8L

3.	**Bipolar Junction Transistor**: Basic Construction, I-V characteristics. **FET**: JFET-Basic construction, principle of operation, Drain and Transfer characteristics. MOSFET- Basic construction, Depletion and Enhancement type, I-V characteristics, FET parameters, MOS capacitor, C-V characteristics, flat band voltage and threshold voltage.	8L
4.	**Opto–Electronics**: Optical absorption in semiconductors, photovoltaic effects, solar cells (p-n junction), Photoconductors, Photodiode, PIN photodiode, Avalanche photodiode, Phototransistor, LED, Semiconductor Laser (p-n junction).	8L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe semiconductor physics, semiconductor types and basics of electronic materials.
2	Describe working principle of various diodes, BJT, MOSFET, solar cell and opto electronic devices
3	Characterize diodes, BJT and MOSFETs
4	Calculate various device related parameters.

Learning Resources:	
1	Neamen- Semiconductor Physics and Devices TMH
2	Streetman Banerjee-Solid State Devices-PHI
3	Boylestad & Nashelsky- Electronics Devices and Circuit Theory- Pearson
4	Milman & Halkias - Electronics Devices and Circuits- TMH
5	Bhattacharya & Sharma- Solid State Electronic Devices- Oxford

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Semiconductor Devices	Dr. G.S. Visweswaran	IIT Delhi
	Course Link: https://nptel.ac.in/courses/117102061		