DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

INSTITUTE OF ENGINEERING & MANAGEMENT, KOLKATA

B.Tech ECE

1.Curriculum Structure

3rd Semester Structure (2024-2028 and onwards)

Sl. No.	Type	Subject Code	Subject Name	L	T	P	Total	Credit
1	CC	PCCEC301	Basic Electronic Devices	3	0	0	3	3
2	CC	PCCEC302	Analog Electronics	3	0	0	3	3
3	CC	PCCEC303	Signals and Systems	3	0	0	3	3
4	CC	PCCEC304	Network Theory	3	0	0	3	3
5	BSC	BSM301	Mathematics-III	3	0	0	3	3
6	MC	MCC301	Constitution of India	1	0	0	1	0
7	GSC	ESP301	Essential Studies for Professionals-III	2	0	0	2	0.5
8	CC	PCCEC391	Basic Electronic Devices Laboratory	0	0	2	2	1
9	CC	PCCEC392	Analog Electronics Laboratory	0	0	2	2	1
10	CC	PCCEC393	Signals and Systems Laboratory	0	0	2	2	1
11	CC	PCCEC394	Network Theory Laboratory	0	0	2	2	1
12	OEC	OEC381	Data Structure & Algorithm (Sessional)	1	0	2	3	2
13	OEC	OEC382	Python Lab (Sessional)	0	0	2	2	2
14	GSC	SDP381	Skill Development for Professionals-III	0	0	2	2	0.5
15	ECP	PRJEC381	Mini Project	-	-	-	1	1
16	Mandatory Course	MAR381	Mandatory Additional Requirement (MAR)	0	0	0	0	0
17	IFC	IFC	Industry and Foreign Certification	0	0	0	0	0
Total								**25**

2.Third Semester Detailed Syllabi

PCCEC301: Basic Electronic Devices

Subject Name: Basic Electronic Devices **Credit: 3** **Lecture Hours: 36**

Relevant Links:

Study Material Coursera NPTEL Linkedin Learning

COURSE OBJECTIVES:

To understand the basics of different electronic devices being used by Electronics Engineers.

To learn different Physical and mathematical concept within the operation of these electronic devices and apply this knowledge in various applications. To understand operations of different opto-electronic and microwave devices and to apply this knowledge in various applications. To learn the basics of Semiconductor physics.

COURSE OUTCOMES:

CO 1: Students will be able to understand the fundamentals of electrical and electronic circuits and working of basic electrical instruments and electronic components.

CO 2: Students will be able to explain the working principle and operations of basic diode, BJT, JFET, MOSFET, different optoelectronic devices, different microwave devices etc. which are normally used in different electronic applications.

CO 3: Students will be able to compare, analyze and find suitable applications within the different electronic and optoelectronic devices in different fields of electronics.

CO 4: Students will develop the understanding regarding application of elementary ideas of electrical and electronics in modern technology.

Module Number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	Semiconductor Electronics and Statistics	Fermi-Dirac Statistics; Fermi and Quasi-Fermi Level; Drift and Diffusion; Conductivity and Mobility; Density of States and Carrier Concentration; Generation and Recombination of Carriers; Semiconductor Equations (Poisson and Continuity); Hall Effect; IC Fabrication (Elementary Discussion).	International Academia: https://ocw.mit.edu/courses/6-012-microelectronicdevices-and-circuits-fall2009/pages/lecture-notes/ . AICTE Model Curriculum: https://www.aicte.gov.in/sites/default/files/Model_Curriculum/Final_ECE.pdf . Industry Mapping: SPICE Software.	5	1. Introduction to programming using PSPICE.
2(a)	Junctions and Contacts	p-n Junction: Operation and Energy Band Diagram; Junction Capacitance and Frequency Limitation; Zener Diode and Breakdown Mechanisms; Heterojunction: Operation and Band Diagram; Ohmic and Schottky Contacts.	International Academia: (https://ocw.mit.edu/courses/6-012-microelectronicdevices-and-circuits-fall-2009/pages/lecture-notes/) . AICTE Model Curriculum: (https://www.aicte.gov.in/sites/default/files/Model_Curriculum/Final_ECE.pdf) . Industry Mapping: SPICE Software.	5	1. Design a forward-biased PN diode and obtain its V-I characteristics using LTspice.2. Design a reverse-biased Zener diode and obtain its V-I characteristics using LTspice.

2(b)	Bipolar Junction Transistors (BJT)	Construction; Operation and Band Diagram; BJT Configurations; Load Line and Q-Point; Amplification; Leakage Currents; Early Effect; Ebers-Moll Equivalent Circuit Model; Frequency Limitation.	International Academia:(https://ocw.mit.edu/courses/6-012microelectronic-devicesand-circuits-fall-2009/pages/lecturenotes/) . AICTE Model Curriculum:(https://www.aicte.gov.in/sites/default/files/Model_Curriculum/Final_ECE.pdf) . Industry Mapping: SPICE Software.	6	1. Draw output characteristics of a BJT in CE configuration for different base currents (Ib = 10 µA, 20 µA) using LTspice.2. Draw input characteristics of a BJT in CE configuration for VCE = 4 V and 10 V using LTspice.3. Design a BJT amplifier using LTspice and determine its voltage gain.

3	Field Effect Transistors (FET)	JFET: Structure, Operation, Pinch-off Voltage.MOSFET: Structure and Operation (Accumulation, Depletion, Inversion); Threshold Voltage; Drain Current Equation (W/L); Drain Characteristics; Small Signal Model; C-V Characteristics of Ideal MOS Capacitor; Channel Length Modulation; MOS Scaling and Short Channel Effects; Substrate Bias Effect; CMOS Working Principle and Switching; Frequency Limitations.FinFET: Structure, Design Challenges, Applications.	International Academia: (https://ocw.mit.edu/cours es/6-012-microelectronicdevices-and-circuits-fall2009/pages/lecturenotes/) . AICTE Model Curriculum: (https://www.aicteindia.org/sites/default/files/Model_Curriculum/Fin al_ECE.pdf) . Industry Mapping: SPICE, TinkerCAD, VHDL, Xilinx.	6	1. Simulate a CMOS inverter with different loads using VHDL and implement it on an FPGA using Xilinx.2. Simulate a CMOS inverter for different values of Kn and Kp using SPICE.3. Obtain MOSFET drain characteristics using VHDL and determine drain resistance for VGS = 3.5 V and 4.5 V.
4	Opto Electronic Devices	Optical Absorption; Absorption Coefficient and Cut-off Wavelength; Luminescence; Photovoltaic Effect; p-n Junction Solar Cell; Photoconductors; Photodiode; Avalanche Photodiode; Phototransistor; LED; Semiconductor Junction Laser.	International Academia:(https://ocw.m it.edu/courses/6-977semiconductoroptoelectronics-theoryand-design-fall-2002/) . AICTE Model Curriculum: (https://www.aicteindia.org/sites/default/files/Model_Curriculum/Fin al_ECE.pdf) Industry Mapping: COMSOL Multiphysics, MATLAB.	4	1. Compare the efficiency of LEDs with different structures using COMSOL Multiphysics.2. Calculate the fill factor of a solar cell.

5	Special Type of Devices	Structure, Characteristics and Operation of PIN Diode, Varactor Diode, Tunnel Diode, Gunn Diode and IMPATT Diode.	International Academia: (https://ocw.mit.edu/cour ses/6-012microelectronic-devicesand-circuits-fall-2009/) AICTE Model Curriculum: (https://www.aicteindia.org/sites/default/files/Model_Curriculum/Fin al_ECE.pdf) . Industry Mapping: COMSOL Multiphysics, MATLAB.	4	1. Study the carrier dynamics of PIN semiconductor devices using COMSOL Multiphysics.

TEXT BOOK:

D A Neamen and D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Edition, 4th.Edition.
Ben. G. Streetman and S.K. Banerjee "Solid State Devices", PHI
Pallab Bhattacharya, “Semiconductor Optoelectronic Devices”, Pearson

PCCEC302: Analog Electronics

Course Code: PCCEC302
Course Title: ANALOG ELECTRONICS
Prerequisites: Basic Electronics
Credit: 3

Course Objective:

1. To understand the methods of biasing of transistors.
2. To design and analyse single stage and multistage amplifier circuits.
3. To analyse the frequency response of small signal amplifiers and design of voltage and power amplifiers using ac models of transistor.
4. To analyse and design active filters.
5. To analyse and design regulated DC power supplies.
6. To impart knowledge on oscillators, feedback amplifiers and tuned amplifiers.

Course Outcomes:

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

CO1	Acquire knowledge on Diode based circuits and regulated power supply.
CO2	Acquire knowledge on different configurations and biasing of bipolar junction transistor (BJT) and FET and their applications.
CO3	Acquire knowledge on analysis and design of transistor-based voltage amplifiers, power amplifiers, feedback amplifiers, oscillators and tuned amplifiers.
CO4	Acquire knowledge on operational amplifier and its applications, active filter circuits and multi-vibrators and will be able to design mixed circuits such as ADC and DACs. .

Relevant Links:

1. Link for Study Material:

https://docs.google.com/document/d/1cdYsDPzIFjHr6uKde63wasr0uxOEjnGP/edit?usp=sharing&ouid=116508199826018918971&rtpof=true&sd=true

2. Link for NPTEL Course:

https://archive.nptel.ac.in/courses/108/105/108105158/

3. Link for Coursera Course:
   i) https://www.coursera.org/learn/linear-circuits-dcanalysis
   ii) https://www.coursera.org/learn/semiconductor-1
   iii) https://www.coursera.org/learn/linear-circuits-ac-analysis?isNewUser=true

4. Link for LinkedIn Learning Course:
https://www.linkedin.com/learning/electronics-foundations-basic-circuits/principles-of-basic-electronic-circuits?autoplay=true&trk=course_preview&upsellOrderOrigin=sem-ga_campid.11663861480_asid.114329355340_crid.481097052948_kw.linkedin%2Blearning%2Bcourses_d.c_tid.kwd-336730500916_n.g_mt.e_geo.9061848

5. Link for Infosys Springboard Course:

i) **https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01398638548131840090 9/overview**

ii) **https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013847872176578560555 52_shared/overview**

iii) **https://infyspringboard.onwingspan.com/web/en/ap/toc/lex_auth_013841728221593600237 0_shared/overview**

Detailed Syllabus:

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	**Diode based circuits, Filters and Regulators: Text book:** Boylestad & Nashelsky (11th edition) Chapter 2 and 15	1. Clippers and Clampers 2. Introduction to full- wave and half-wave rectifiers. Capacitor filter. Inductor filter, LC and π − section filter. Series and Shunt voltage regulator, percentage regulation. Regulator ICs 78xx and 79xx series. Introduction to SMPS.	As per International Standards : (https://explorecourses.stanford.edu/search?q=EE101A) (https://explorecourses.stanford.edu/search?q=EE101B) https://ocw.mit.edu/courses/6-101-introductory-analog-electronics-laboratory-spring-2007/pages/syllabus/ and AICTE-prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ ECE.pdf) ***Industry Mapping:*** LT-SPICE software, LabView, Proteus. Hardware Chipset: IN4001/4007, 7815, 7915.	4	1. Design of different clippers and clampers using LT-SPICE/ MATLAB/ Proteus simulation software 2. Simulation of full-wave and half-wave rectifiers with and without filter using LT-SPICE/Proteus software to study of Ripple and Regulation characteristics.
2.	**Biasing of BJT and FET.** **Stability of Q- point.** **Text book:** Boylestad & Nashelsky (11th edition) Chapter 4	Introduction to BJT and FET biasing, Q-point selection, Diode Compensation. Bias stabilization and stability factors, Current Mirror concept. Various configurations (such as CE/CS, CB/CG, CC/CD) and	As per International Standards : (https://explorecourses.stanford.edu/search?q=EE101A) (https://explorecourses.stanford.edu/search?q=EE101B) https://ocw.mit.edu/courses/6-101-introductory-analog-electronics-laboratory-spring-	6	1. Simulation of transistor amplifier circuit with self bias in CE configuration using LT-SPICE/ Proteus software to study parameters of Q-point.

		their features.	2007/pages/syllabus/ and AICTE-prescribed syllabus : :(https://www.aicte-india.org/sites/default/files /Model_Curriculum/Final_ ECE.pdf) ***Industry Mapping:*** LT-SPICE software, LabView, Proteus. Hardware Chipset: BC547, BC557, SL100, 2N5457, 2N5460.		
3	**Transistor Amplifier Circuits** **Text book:** Boylestad & Nashelsky (11th edition) Chapter 5	**Small Signal Model:** Re and h-parameter model of transistors. Analysis of transistor amplifiers, expression for voltage gain, current gain, input and output impedance. Design of transistor amplifier. **High frequency model :** Hybrid-π *model* of transistor, short circuit current gain and β cut off frequency, Functions of	As per International Standards : (https://explorecourses.stanford.edu/search?q=EE101A) (https://explorecourses.stanford.edu/search?q=EE101B) https://ocw.mit.edu/courses/6-101-introductory-analog-electronics-laboratory-spring-2007/pages/syllabus/ and AICTE-prescribed syllabus : :(https://www.aicte-india.org/sites/default/files /Model_Curriculum/Final_ ECE.pdf)	6	2. Simulation of transistor amplifier circuit with potential divider bias in CE configuration using LT-SPICE/Proteus software to study output voltage and gain for an input signal. 3. Simulation of two stages R-C coupled

		all parameters of high freq. model, equivalent circuit, Frequency response of single stage and multi stage amplifier, RC coupled amplifier, derivation of voltage gain, current gain, input impedance and output impedance, frequency response characteristics, lower and upper half frequencies, bandwidth, and concept of wide band-amplifier. Tuned Amplifier .	***Industry Mapping:*** LT-SPICE software, LabView, Proteus. Hardware Chipset: BC547, BC557, SL100, 2N5457, 2N5460.		amplifier using LT-SPICE/Proteus software to study of its gain and bandwidth.

4	**1. Feedback Amplifiers** **2. Oscillators** **Text Book:** Chattopadhyay and Rakshit Chapter 10 and 11 **3. Power Amplifiers.** **Text Book:** i) Boylestad & Nashelsky	Introduction to Feedback concept, negative & positive feedback, voltage/ current, series/shunt feedback topologies. Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators (Astable, Monostable and Bistable). Classification of Power Amplifiers	As per International Standards : (https://explorecourses.stanford.edu/search?q=EE101A), (https://explorecourses.stanford.edu/search?q=EE101B), https://ocw.mit.edu/courses/6-101-introductory-analog-electronics-laboratory-spring-2007/pages/syllabus/ and AICTE-prescribed syllabus : (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) ***Industry Mapping:*** LT-SPICE software, LabView, Proteus. Hardware Chipset: SL100, IC 741.	4	1. Simulation of Phase shift oscillator using OPAMP and LT-SPICE/Proteus software to study frequency of oscillation by varying component values. 2. Study Class B Push-Pull Amplifier with small input signal. 3. Study of Class C Tuned Amplifier with small input signal.

	(11th edition) Chapter 12				

5	**1. Operational Amplifier:** **Text Book:** R. A. Gayakwad. Chapter 3	2. Introduction to operational amplifier, Ideal OP AMP, Differential Amplifier, Constant current source (current mirror etc.), level shifter, CMRR, Open & Closed loop circuits, importance of feedback loop (positive & negative), inverting & non inverting amplifiers, voltage follower/buffer circuit.	As per International Standards : (https://explorecourses.stanford.edu/search?q=EE101A), (https://explorecourses.stanford.edu/search?q=EE101B), https://ocw.mit.edu/courses/6-101-introductory-analog-electronics-laboratory-spring-2007/pages/syllabus/ and AICTE-prescribed syllabus : (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ ECE.pdf), Industry Mapping: LT-SPICE software, LabView, Proteus. Hardware Chipset: IC741, IC328.	6	4. Simulation of ADC using IC AD570, and using LT-SPICE/ Proteus software. 5. Simulation of DAC using DAC 0808 and usingLT-SPICE/ Proteus software. 6. Simulation of Inverting and Non-Inverting Amplifier using Op-Amp and using LT-SPICE/Proteus software.
	2. Applications of Operational Amplifiers: Text Book: R. A. Gayakwad. Chapter 6	Applications of Operational Amplifiers: adder, integrator & differentiator, comparator. Schmitt Trigger, Instrumentation Amplifier, Log & Anti-log amplifiers, Trans-conductance multiplier, Precision Rectifier, voltage to current and current to voltage converter, free running oscillator.	As per International Standards: (https://explorecourses.stanford.edu/search?q=EE101A) ,(https://explorecourses.stanford.edu/search?q=EE101B), https://ocw.mit.edu/courses/6-101-introductory-analog-electronics-laboratory-spring-2007/pages/syllabus/ and AICTE-prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final ECE.pdf), ***Industry Mapping:*** LT-SPICE software, LabView, Proteus. Hardware Chipset: IC741, IC328,	6	7. Simulation of differentiator and integrator circuit using Op-Amp and using LT-SPICE/Proteus software. 8. Simulation of Logarithmic and Anti Logarithmic Amplifier circuit using IC 741 and with LT-SPICE/ Proteus software.

	3. **Digital-to-Analog Converters (DAC), Analog-to-Digital Converters (ADC) and Switched-Capacitor Circuits** **Text Books:** Paul R.Gray & Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition	Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc. Analog-to-digital converters (ADC): Single slope, dual slope, successive approximation, flash etc. Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.	Multiplier IC AD633, Logarithmic Multiplier IC TL441, Anti Logarithmic Amplifier ICL 8049.		9. Simulation of practical configurations, application in amplifier, integrator, ADC etc using Op-Amp and using LT-SPICE/Proteus software.

Text book and Reference books:

Text Book:

1. A.V.N. Tilak, Design of Analog Circuits, Khanna Publishing House, 2022.
2. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
3. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
4. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, Edition IV
5. Paul R.Gray & Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition
6.Boylestad, Robert L., and Louis Nashelsky. Electronic devices and circuit theory. Prentice Hall, 2012.
7.Electronics Fundamentals and Applications, D Chattopadhyay and P C Rakshit.
8. Op-amps and Linear IC's, R.A. Gayakwad, PHI.

Reference Books:

1. Microelectronic Circuit- Analysis & Design, Rashid, Cenage Learning.
2. Electronic Circuits: Discrete & Integrated, 3rd Edition, Schilling & Belove, Mc Graw HillCompany.
3. Electronic principles, 6th Edition, Malvino, Mc Graw Hill Company.
4. Operational Amplifier & Linear IC's, Bell, Oxford University Press.
5. 2000 Solved Problems in Electronics, Jimmie J. Cathey, Mc Graw Hill Inc.
6. Electronic Devices -System & Application, Robert Diffenderfer, Cengage Learning.
7. Op- Amps & Linear Integrated Circuits, Ravi Raj Dudeja & Mohan Dudeja, Umesh Publication
8. Principles of Electronics, V K Mehta and Rohit Mehta, S Chand and Company Publication

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1:	S	S	W	W	W	-	-	-	-	W	-	S
CO2:	S	S	M	M	M	W	-	-	-	W	-	S
CO3:	S	S	S	S	S	M	W	-	W	W	S	S
CO4:	S	S	M	W	-	-	-	-	-	-	-	S

S: Strong **M: Medium** **W: Weak**

PCCEC303: Signals and Systems

SUBJECT: SIGNALS AND SYSTEMS
SUBJECT CODE: PCCEC303

Subject Code : PCCEC303	**Category : Professional Core courses**
Subject Name : Signals and Systems	Semester : 3rd
L-T-P : 3-0-0 (Total Contact Hrs. 3)	Credit: 3
Pre-Requisites: School level mathematics: Sequence and series, algebra of complex numbers, ba- sic trigonometry. Calculus: Differential and Integral calculus (single variable). Knowledge of dif- Ferential equations are helpful but not required. Co-requisites: Basic circuit analysis ohm's law, KVL, KCL.	

Course Objective:

1. To explain signals and systems representations/classifications and also describe the time and frequency domain analysis of continuous time signals with Fourier series, Fourier transforms and Laplace transforms.
2. To understand Sampling theorem, with time and frequency domain analysis of continuous time signals with Fourier series, Fourier transform and Z transform.
3. To present the concepts of convolution and correlation integrals and also understand the properties in the context of signals/systems and lay down the foundation for advanced courses.
4. To understand the basic concepts of state space representation of a system and conversion of the transfer function model into state space and vice versa.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Signals and systems as seen in everyday life, and in various branches of engineering and science. Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift- invariance, causality, stability, realizability. Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs. Characterization of causality and stability of linear shift invariant systems. System representation through differential equations.	10
2	Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response. Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases. Evolution of Transforms: Fourier Transform, Laplace Transform, Z- transform (single sided and Double sided).	12

3	The Laplace Transform, notion of Eigen functions of LSI systems, a basis of Eigen functions, region of convergence, poles and zeros of system, solution to differential equations and system behavior using Laplace Trans- formation. The z-Transform for discrete time signals and systems- Eigen function region of convergence, z-domain analysis. The Sampling Theorem and its implications, Spectra of sampled signal Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems.	12
4	State-space representation of systems. State-Space analysis, Multi-input, multi-output representation. State Transition Matrix and its role.	10

Books Recommended:

1. B. P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
2. Douglas K.Lindner, "Introduction to Signals and Systems", McGrawill International Edition.
3. Simon Haykin, Barryvan Veen, "Signals and Systems", John Wiley and Sons (Asia).
4. Robert A. Gabel, Richard A. Roberts,"Signals and Linear Systems", John Wiley and Sons,1995.
5. M. J. Roberts, "Signals and Systems Analysis using Transform methods and MATLAB",TMH.
6. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi,2001.
7. Ashok Ambardar, "Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company),1999.
8. R. Anand, Signals and Systems, Khanna Publishing House, 2018.

Course Outcomes:

Mapping of CO with PO (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

CO PO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12
1	2	2	1	1								
2	3	1	2	1								
2	3	3	1	2								
4	2	2	2	3								

PCCEC304: Network Theory

Code: PCCEC304
Course Title: NETWORK THEORY
Prerequisites: Basic Electrical
Credit: 3

Course Objectives:

To learn about different types of network theorem and to apply this knowledge in circuit analysis.
To learn about the transient response of a circuit.
To understand the application of Laplace transform and graph theory in circuits.
To learn about the resonating nature of a circuit.
To learn the two pot parameters and their applications in circuit

Course Outcomes:

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

CO1	After completing this course, the students will be able to analyze a circuit with respect to node voltages and currents.
CO2	They will be able to understand the transient and steady state response of the circuit.
CO3	They will be able to analyze resonating and coupled circuits.
CO4	They will be able to analyze simple two-port circuit and analyze circuits using Graph Theory.

Relevant Links:

Link for Study Material:https://docs.google.com/document/d/1-1Og2Hu2y8fPVfcg3-RbziRTt3UJ96JG/edit
Link for Coursera Course:
Link for LinkedIn Learning Course:
Link for NPTEL Course:
Link for Infosys Springboard Course:

Detailed Syllabus:

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	Network Theorems Text Book: D Roy Chowdhury Chapter	Network Elements,KCL,KVLBasic nodal and mesh analysis, linearity, superposition and source transformation, Thevinin's Theorem, Norton's and maximum power transfer theorem and useful circuit analysis techniques, Tallegen's theorem ,network topology,Active Networks,Bisection Theorems	As per International Standards : Syllabus (stanford.edu) and AICTE-prescribed syllabus: (https://www.aicteindia.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) Industry Mapping: Circuit Simulation using MATLAB,LTSPICE,PROTEUS	6	Verification of various theorems using Hardware and Simulation.
2	TRANSIENT ANALYSIS: Text Book: A. Chakrabarty	Natural response-Forced response - Transient response of RC, RL and RLC circuits to excitation by Step Signal, Impulse Signal and exponential sources - Complete response of RC, RL and RLC Circuits to sinusoidal excitation For various types of inputs.	As per International Standards : Syllabus (stanford.edu) and AICTE-prescribed syllabus: (https://www.aicteindia.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) Industry Mapping: Circuit Simulation using MATLAB,LTSPICE,PROTEUS	6	Observe the transient response of various RC,RL and RLC series parallel circuits for different values of circuit parameters.

3	Laplace transform and its circuit applications Text Book: M.E. Van Valkenburg	Laplace transform, initial and final value theorem, circuit analysis in s domain, frequency response. Waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions. Concept of pole, zero and transfer function and pole-zero cancellations .	As per International Standards : Syllabus (stanford.edu) and AICTE-prescribed syllabus: (https://www.aicteindia.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) Industry Mapping: Circuit Simulation using MATLAB,LTSPICE,PROTEUS	8	Perform Laplace and Inverse Laplace of various functions using MATLAB

4	RESONANCE AND COUPLED CIRCUITS Text Book: A. Chakrabarty Van Valkenberg	Resonance - Series resonance - Parallel resonance - Variation of impedance with frequency - Variation in current through and voltage across L and C with frequency – Bandwidth - Q factor - Selectivity. Self inductance - Mutual inductance - Dot rule - Coefficient of coupling - Analysis of multi winding coupled circuits - Series, Parallel connection of coupled inductors - Single tuned and double tuned coupled circuits.. Amplifiers	As per International Standards : Syllabus (stanford.edu) and AICTE-prescribed syllabus: (https://www.aicte- india.org/sites/default/files /Model_Curriculum/Final_ ECE.pdf) Industry Mapping: Circuit Simulation using MATLAB, LTSPICE, PROTEUS	8	Design of RC, RL, RLC Series and parallel circuits

5	TWO PORT NETWORKS: Text Book: A. Chakrabarty Van Valkenberg	Two port networks, Z parameters, Y parameters, Transmission (ABCD) parameters, Hybrid (H) Parameters, Interconnection of two port networks, Symmetricity and reciprocity conditions. Activity,Passivity,Reciprocity Reflectors,Mutators	As per International Standards : Syllabus (stanford.edu) and AICTE-prescribed syllabus: (https://www.aicteindia.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) Industry Mapping: Circuit Simulation using MATLAB,LTSPICE, PROTEUS	6	Find out Y, Z, h and ABCD parameters of various two port network. Find symmetricity and Reciprocity of 2Port Network
6	GRAPH THEORY IN CIRCUITS Text Book: A. Chakrabarty	Graph of a network - Incident and reduced incident matrices – Trees –Cut sets - Fundamental cut sets – Cut set matrix – Tie set matrix	As per International Standards : Syllabus (stanford.edu) and AICTE-prescribed syllabus: https://www.aicteindia.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) Industry Mapping: Circuit Simulation using MATLAB,LTSPICE, PROTEUS	4	
7.		Basics of Circuit Synthesis: Time Varying Circuits,		2	

Text Books:

V. Valkenbeg, Network Analysis , Pentice Hall India

D Roy Chowdhury, Networks and Systems, New Age International Publishers

Reference Books:

Fundamentals of Electric Circuits, Charles K. Alexander, Mc Graw Hill

Network Analysis and Synthesis, S Ghosh , A. Chakraborty

A William Hayt, “Engineering Circuit Analysis” 8th Edition, McGraw-Hill Education

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1:	S	S	W	W	W	-	-	-	-	W	-	S
CO2:	S	S	M	M	M	W	-	-	-	W	-	S
CO3:	S	S	S	S	S	M	W	-	W	W	S	S
CO4:	S	S	M	W	-	-	-	-	-	-	-	S

S: Strong M: Medium W: Weak

BSM301: Mathematics- III

Credit: 3 Lecture Hours: 42

Pre-Requisites: Permutation & Combination, Concept of Basic Probability, Evaluation of definite, improper and infinite integrals, Concept of β & Γ functions.

Relevant Links:

Coursera: https://www.coursera.org/learn/bits-probability-and-statistics?

NPTEL: https://nptel.ac.in/courses/111102160?

Linkedin Learning: https://www.linkedin.com/learning-login/share?account=229219690&forceAccount=true&redirect=https%3A%2F%2Fwww%2Elinkedin%2Ecom%2Flearning%2Flearning-matlab-22871829&shareId=d356a54d-671a-469d-91fe-fe9553764236

Infosys Springboard: https://infyspringboard.onwingspan.com/web/en/login

Study Material Link (BL 4, 5,6) https://drive.google.com/drive/folders/19umqy3stib1-wuHy0h-p0arM0NkIzdxC?usp=sharing

COURSE OBJECTIVES:

1. The syllabus will prepare the learners for Engineering Exit Examinations, ESE and campus placements.
2. Students will apply concepts of various probability distributions to find probabilities.
3. Students will make estimations for a mean, variance, standard deviation and proportions for big data.
4. Students will be eligible to work in the Data domain which is the emerging technology of the future and create more opportunities for creative work.
5. Students will be able to describe and quantify the uncertainty inherent in predictions made by machine learning models.

COURSE OUTCOMES:

CO	Course Outcomes
CO 1	Illustrate the ideas of probability and random variables, various discrete and continuous probability distributions with their properties and their applications in physical and engineering environment that will make a bridge between elementary statistical tools and probability theory.
CO 2	Find the inter-relation between two or more phenomena with the help of curve fitting.
CO 3	Understand the basic components of sampling and have the knowledge on exact sampling distributions which are essential for estimating and testing hypothetical statements. Know the various sampling methodologies and their efficiencies in theoretical and practical aspects.
CO 4	Estimate and test the parameters associated with the relevant areas for forecasting and verification of economic theory
CO 5	Apply the statistical tools in business, economical and commercial areas for analyzing problems and to make better decisions for future in their fields.

Detailed Syllabus:

Module No.	Topic	Sub-topics	Mapping with Chapters of the Text Book	Mapping with Industry & International Academia	Lecture hour	Corresponding Lab Assignment
1	**Random Variables and Probability Distributions**	*Discrete Random Variable:* Discrete Probability Distribution, Expectation and Variance of random variables; Binomial and Poisson Distributions; Mean, Variance and Moment Generating Functions of Binomial and Poisson Variates; Convergence of Binomial to Poisson Variate.	Chapters 2 and 3/Text Book 1 Chapter 12 /Text Book 2	https://ocw.mit.edu/courses/18-05-introduction-to-probability-and-statistics-spring-2022/	**12**	"R" software for statistical computing

		Continuous Random Variable; Continuous Probability Distributions, Expectation and Variance of random variables, Exponential, Normal Distributions; Mean, Variance and Moment Generating Functions of the corresponding variates.				
2	**Method of Least Squares and Curve Fitting**	Principle of Least Squares, Curve fitting by the method of Least Squares - fitting of straight lines, second degree parabolas and exponential curves.	Chapter 9/Text Book 1 Chapter 8 /Text Book 2	https://ocw.mit.edu/courses/18-05-introduction-to-probability-and-statistics-spring-2022/	**4**	"stata": statistical software for data science
3	**Sampling and Sampling Distributions**	Population and Sample, Sampling With and Without Replacement (SRSWR and SRSWOR); Random Samples, Population Parameters, Sample Statistics, Sampling Distributions, Standard Error and Probable Error; Sample Mean, Sampling Distribution of Means; Sample Proportion, Sampling Distribution of Proportions, Sample Variances, Sampling Distribution of Variances; Case where Population Variance is unknown; Central Limit Theorem (Statement only); Degrees of freedom, Chi-square distribution, Mean & Variance of Chi-square variate.	Chapter 11 /Text Book 1 Chapter 13/Text Book 2	https://www.cl.cam.ac.uk/teaching/2021/IntroProb/materials.html	**8**	"stata": statistical software for data science

4	**Estimation of Parameters**	Point and Interval estimations, Biased and Unbiased estimators, Minimum Variance Unbiased Estimator (MVUE), Consistent Estimator, Maximum Likelihood Estimation of Parameters, Applications in populations following theoretical distributions (Binomial, Poisson and Normal), Calculation of confidence limits for population mean and population proportions.	Chapter 12 /Text Book 1 Chapters 14/ Text Book 2	https://ocw.mit.edu/courses/1-010-uncertainty-in-engineering-fall-2008/	**6**	"R" software for statistical computing
5	**Testing of Hypothesis**	*Large Sample Test***:** Statistical Hypotheses, Test Statistic, Best Critical Region, Test for single mean, difference of means, single proportion, difference of proportions, and difference of standard deviations. *Small Sample Test:* Test for single mean, difference of means and correlation coefficients, Test for ratio of variances, Chi-square test for goodness of fit and independence of attributes.	Chapter 13/ Text Book 1 Chapter 14/ Text Book 2	https://ocw.mit.edu/courses/6-041-probabilistic-systems-analysis-and-applied-probability-fall-2010/	**12**	"R" software for statistical computing

TEXT BOOK:

1. **Saktipada Nanda and Sibashis Nanda, "**A Course on Probability & Statistics", 2nd Edition (2024), Mindprobooks Academic Series [Available in flipkart.com/amazon.in]
2. **N. G. Das,** "Statistical Methods", Combined Edition Vol. 1 &2 (2017) McGraw Hill Education

REFERENCE BOOKS:

1. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 6th Edition (2020), Academic

2. Douglas C, Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, 7th edition (2018), John Wiley & Sons.

3. Murray R. Spiegel, John J. Schiller and R. Alu Srinivasan, "Schaum's Outline of Probability & Statistics", 4th Edition (2012), McGraw Hill Education.

PCCEC391: Basic Electronic Devices Laboratory

L-T-P	0-0-2 (Total Contact Hrs.2)	Credit: 1	Pre-Requisites:1. Basic Electronics 2. Basic Physics

Part -A

Sl No.	Assignments
1. (a)	CHARACTERISTICS OF PN JUNCTION DIODE To Plot the Volt Ampere Characteristics of PN Junction Diode under Forward and Reverse Bias Conditions. To find the Cut-in voltage, Static Resistance, Dynamic Resistance for Forward Bias & Reverse Bias.
	Study the characteristics of PN junction diodes using 'LT Spice' and compare the result with the hardware.
	Application in project: PN junction diode as a reverse current blocking component in a solarpowered phone charger. Extension Ideas: Replace the diode with a Schottky diode and compare characteristics. Use an Arduino-based battery level indicator. Integrate with IoT to monitor solar input/output voltage remotely.
1. (b)	CHARACTERISTICS OF ZENER DIODE & LOAD REGULATION To Obtain the Forward Bias and Reverse Bias characteristics of a Zener diode. Find out the Zener Breakdown Voltage from the Characteristics. To Obtain the Load Regulation Characteristics.
	Study the characteristics of Zener junction diodes using 'LT Spice' and compare the result with the hardware.

	Application in project: Smart Low-Voltage Cut-Off System for IoT Devices using Zener Diode Extension Ideas: Smart Overvoltage & Undervoltage Protection System Using Zener and Comparator
2.	COMMON BASE BIPOLAR TRANSISTOR CHARACTERISTICS a) To plot the Input and Output characteristics of a transistor connected in Common Base Configuration. To find the h – parameters from the characteristics.
	Study the characteristics of BJT in CB mode using 'LT Spice' and compare the result with the hardware.
	Application in project: High-Frequency RF Signal Amplifier using Common-Base Configuration Extension Ideas: Design of a Cascaded RF Amplifier Using Common-Base and CommonEmitter Stages
3.	COMMON EMITTER BIPOLAR TRANSISTOR CHARACTERISTICS a) To plot the Input and Output characteristics of a transistor connected in Common Emitter Configuration. b) To find the h– parameters from the characteristics.
	Application in project: Audio Signal Amplifier for Portable Speaker using Common-Emitter Configuration

	Extension Ideas: Smart Audio Level-Activated Amplifier using CE Configuration and Automatic Gain Control (AGC)
	Audio Signal Amplifier for Portable Speaker using Common-Emitter Configuration
4.	JFET DRAIN & TRANSFER CHARACTERISTICS (COMMON SOURCE) a) Drain characteristics b) Transfer Characteristics. c) To find rd, gm, and μ from the characteristics.

	Study the drain and transfer characteristics of common source JFET of using ‘LT Spice’ and compare the result with the hardware.
	Application in project: JFET-Based Electret Microphone Preamplifier for Voice Applications. Extension Ideas: Design of a JFET-Based Automatic Volume Leveler for Audio Input Circuits
5.	MOSFET DRAIN & TRANSFER CHARACTERISTICS (COMMON SOURCE) a) Drain characteristics b) Transfer Characteristics. c) To find rd, gm, and μ from the characteristics.
	Study the drain and transfer characteristics of common source MOSFET of using ‘LT Spice’ and compare the result with the hardware.
	Application in project: Battery Level Indicator with MOSFET Cutoff Control Extension Ideas: Smart Battery Management System (BMS) with Multi-Level Cutoff and MOSFET Load Switching
6.	FREQUENCY RESPONSE OF RC COUPLED BJT AMPLIFIER (i) To find the frequency vs voltage gain. (ii) To find mid-band voltage gain. (iii) To find upper and lower cut-off frequency.
	STUDY THE FREQUENCY RESPONSE OF RC COUPLED BJT AMPLIFIER USING LT SPICE
	Application in project: a) AI-Assisted Gain Prediction and Cut-Off Frequency Estimation in BJT Amplifier Circuits b) Development of a Signal Conditioning Circuit Based on BJT Amplifier for Sensor Applications
7.	FREQUENCY RESPONSE OF JFET Draw the graph in semilog graph paper Find the Bandwidth
	Study the frequency response of JFET of using ‘LT Spice’ and compare the result with the hardware.
	Application in project: JFET Amplifier for Wireless Audio Signal Transmission Preamp Extension Ideas: Smart Wireless Audio Transmission System with Noise Filtering and Gain Control Using JFET Amplifier

8.	STUDY THE CHARACTERISTICS OF PHOTOTRANSISTOR. Plot the graphs of VCE, Supply voltage, IC and Illumination. (i) VCE, IC where Illumination=constant (ii) Illumination vs IC where supply voltage=constant
	Recent project work related to Phototransistors.
9.	STUDY THE I-V CHARACTERISTICS OF LIGHT EMITTING DIODE (LED).
	Recent project work related to LED.
10.	STUDY THE CURRENT-VOLTAGE-ILLUMINATION CHARACTERISTICS OF LDR. Plot the graphs of Current, Voltage, Resistance and Illumination.
Sl No.	Assignments
	Current vs Voltage where Illumination=constant Illumination vs Current where Supply voltage=constant Illumination vs Resistance where Supply voltage=constant
	Recent project work related to LDR.
11.	DESIGN BJT AMPLIFIER CIRCUIT.
	Design BJT amplifier 'LT Spice' and compare the result with the hardware.
	Application in project: Design of a Microphone Preamplifier for Podcasting Using BJT Amplifier Extension Ideas: Design and Analysis of a Multi-Stage BJT Audio Amplifier with Tone Control
12.	Special project work where students can use p-SPICE / Silvaco / Meep / Xilinx/ FPGA

Part -B
Generative AI Modules

1. **Gen AI-Assisted Circuit Synthesis**

Objective: Use an LLM (e.g., ChatGPT o3) + Python to draft LTspice netlists matching a given specification (e.g., CE amplifier with gain $\approx 50 \pm 5$ dB).

Tasks: Craft a prompt describing desired gain, bandwidth, and component limits.

Simulate AI-generated netlist; measure gain & BW.

Iterate prompts to meet spec within three attempts; document changes.

Deliverable: Reflection on prompt engineering vs manual design.

Skill Focus: Prompt tuning · AI code generation · Rapid verification.

2. **AI-Driven Fault Diagnosis & Optimization**

Objective: Combine oscilloscope screenshot data + LLM reasoning to locate component faults and suggest fixes.
Tasks: Inject a controlled fault (e.g., open-collector resistor).
Capture waveform, feed textual description to LLM.
Implement AI suggestion; verify restored performance.
Compare time-to-solution with traditional troubleshooting.
Deliverable: Short report + timing chart.
Skill Focus: Data-to-text transformation · AI reasoning · Comparative analysis.

3. **Gen AI-Enhanced Technical Documentation & Visualization**
Objective: Leverage Gen AI (DALL·E 3 / Stable Diffusion) for schematic illustrations, and LLMs for automated lab-report drafts.
Tasks: Generate an infographic explaining MOSFET transfer curves.
Auto-draft "Theory" & "Procedure" sections; students critique and correct inaccuracies.
Evaluate originality with plagiarism checker; reflect on ethical use.
Deliverable: Finished report section + critique log.
Skill Focus: AI content generation · Visual communication · Academic integrity.

PCCEC392: Analog Electronics Laboratory

Semester: 3rd L-T-P: 0-0-2 (Total Contact Hrs. 2)

Pre-Requisites: Basics Electronics

Course Outcome:

CO1: Design, implement, and analyze basic analog electronic circuits such as rectifiers, multivibrators, and operational amplifier-based circuits using theoretical concepts and laboratory instruments.

CO2: Design and evaluate transistor-based amplifier circuits, including CE amplifiers, RC-coupled amplifiers, and push-pull amplifiers, by analyzing gain, bandwidth, frequency response, and distortion characteristics.

CO3: Design, simulate, and experimentally validate analog functional circuits such as logarithmic/anti-logarithmic amplifiers, active filters, and Wien Bridge oscillators to meet specified performance requirements.

CO4: Utilize AI and Generative AI tools to assist in circuit design, parameter estimation, troubleshooting, optimization, simulation, and comparison of theoretical and experimental results for analog electronic systems.

Week	Experiment	Learning Outcomes	Laboratory Activities	AI / GenAI Integration	Assessment
Week 1	Rectifiers (Half-Wave, Full-Wave & Bridge)	Understand rectification, ripple factor, efficiency and PIV.	Design and implement half-wave, full-wave and bridge rectifiers. Measure output voltage, ripple factor and efficiency.	Use ChatGPT/Gemini/Copilot to explain circuit operation, predict ripple factor, efficiency and PIV. Compare AI predictions with practical results.	Observation, Viva, Lab Record
Week 2	555 Timer Multivibrators	Design astable and monostable multivibrators. Calculate frequency and duty cycle.	Construct astable and monostable circuits using IC 555. Verify output waveform using CRO.	Use GenAI to generate design equations, duty cycle calculations and troubleshooting suggestions.	Circuit Performance, Viva
Week 3	Op-Amp Arithmetic Circuits & Amplifiers	Understand op-amp applications in analog computation and amplification.	Implement adder, subtractor, inverting and non-inverting amplifiers. Verify gain experimentally.	Generate circuit configurations and resistor values using AI. Compare AI-generated values with manual calculations.	Lab Performance, Record
Week 4	BJT CE Amplifier	Analyze voltage gain, biasing and frequency response of CE amplifier.	Design CE amplifier with and without feedback. Measure gain and bandwidth.	Use AI tools to estimate transistor β, gain, bandwidth and biasing network. Compare theoretical and experimental results.	Viva, Experiment Accuracy
Week 5	RC Coupled Amplifier & Push-Pull Amplifier	Study multistage amplification and Class-B power amplification.	Design RC coupled amplifier and Class-B push-pull amplifier. Observe frequency response and crossover distortion.	Use AI to recommend component values and suggest methods to reduce crossover distortion.	Performance Evaluation
Week 6	Log & Anti-Log Amplifiers	Understand logarithmic and exponential signal processing.	Implement log and anti-log amplifier circuits and verify transfer characteristics.	Use GenAI to identify real-life applications such as sensor linearization, analog computation and signal compression.	Viva, Lab Report
Week 7	GenAI-Assisted Active Filter Design (LPF & HPF)	Design first-order active filters and analyze frequency response.	Design LPF and HPF for specified cut-off frequency. Verify response experimentally.	Use AI to generate filter designs and compare with manually designed circuits using simulation and hardware.	Observation, Design Report
Week 8	GenAI-Guided Wien Bridge Oscillator	Design sine wave oscillator and study frequency stabilization.	Design Wien Bridge Oscillator, measure oscillation frequency and output waveform.	Use AI to recommend component values, tuning methods and stabilization techniques. Compare AI suggestions with practical implementation.	Final Viva, Lab Evaluation

PCCEC393: Signals and Systems Laboratory

Subject Code : PCCEC393	Category : Professional Core course
Subject Name : Signals & Systems Lab	Semester : 3rd
L-T-P : 0-0-2 (Total Contact Hrs. 2)	Credit : 1
Pre-Requisites: Mathematics, Network Theory	

Course Objective:

1. Understanding of Signals and Systems is essential for a proper appreciation and application of other parts of electronics engineering, such as Digital Signal Processing, Analog and Digital Communication systems to be taught in the forthcoming semesters. 2. The course lays the mathematical foundation for the study of signals and systems, classification of signals - continuous time and discrete time signals and properties of systems.

3. Helps the students in dealing with signals in both time and frequency domains and responses of the LTI systems in both time and frequency domains.

4. This subject, which consolidates and expands student knowledge from basic mathematics, constitutes an essential conceptual framework from which to understand a variety of engineering systems.

5. The subject also deals with introductory ideas on the topics of filtering, sampling, Z Transform and Laplace Transform.

Course Content:

Module No.	Description of Topic	Contact Hrs.	Blooms Level	PO(1..12) Mapping
1.	Study to identify the basic differences between continuous and discrete time signals & systems.	2	L2 (Understand)	PO1, PO5
2.	Study to simulate the signals (sinusoidal, impulse, ramp and step signals) in Matlab/Octave.	2	L2 (Understand) L3 (Apply)	PO1, PO5

3.	To study Linear convolution theorem in time and frequency domain in Matlab / Octave.	2	L2 (Understand) L3 (Apply)	PO1, PO5
4.	Fourier & Laplace transform of different signals.	2	L3 (Apply) L4 (Analyze)	PO1, PO2, PO5
5.	Verification of sampling theorem .To study of sampling of an analog Signal and its effects with different sampling rates(over, under and critical sampling cases)	2	L3 (Apply) L4 (Analyze)	PO1, PO2,PO5
6.	Z-transform of different discrete time signals. Correlation of two signals (auto correlation & cross correlation).	2	L2 (Understand) L3 (Apply)	PO1, PO2 PO5
7.	Design of a first order low-pass filter with a given cut- off frequency.	2	L3 (Apply) L4 (Analyze)	PO1, PO3
8.	Design of a first order high-pass filter with a given cut-off frequency.	2	L3 (Apply) L4 (Analyze)	PO1, PO3
9.	Design of a first order band-pass filter with a given cut- off frequency.	2	L3 (Apply) L4 (Analyze)	PO1, PO3
10.	Design of a first order band-reject filter with given cut- off frequency.	2	L3 (Apply) L4 (Analyze)	PO1, PO3

Course Outcomes:

1. Ability to identify the basic differences between continuous and discrete time signals & systems and analyze both time and frequency domain.
2. Ability to apply Laplace transform and Z transform in the analysis of continuous time and discrete time signals and systems.
3. Ability to compute the output of a LTI system (both continuous and discrete time) by convolution and sampling of continuous time signals and verification of the same.
4. Ability to design suitable active filters of first order(LPF,HPF and BPF) required for signal processing applications.

Learning Resources:

1. Laboratory manual provided from the organization.

2a) Signals and Systems:Allen Opphenium,Wilsky,

2b) Signals and Systems:Simon Haykin,Vary Veen.

3. MATLAB/https://octave-online.net.

PCCEC394: **NETWORK THEORY LABORATORY**

Subject Code : PCCEC394	**Category : Professional Core course**
Subject Name : Network Theory Lab	Semester : 3rd
L-T-P : 0-0-2 (Total Contact Hrs. 2)	Credit : 2
Pre-Requisites: Mathematics, Network Theory	

Course Objective:

1. To develop an understanding of Transient response of RL and RC circuits after application of AC and DC signals.
2. To develop an understanding of Resonance occurs in the RLC Circuit after application of AC power supply.
3. To develop an understanding of different theorems and it application in the AC and DC Circuits.
4. To develop an understanding of Impedance and Admittance Parameters of Two-Port Network.
5. To develop an understanding of Basic Signal and Generations of signals, Representation of Poles and Zeros in S-Plane, Determination of partial fraction expansion in S-Domain and cascade connection of second order systems and Determination of Laplace Transform, different time domain functions, and Inverse Laplace using MATLAB.

Course Content:

Module No.	**Description of Topic**	**Contact Hrs.**	**Blooms Level**	**PO(1..12) Mapping**
1.	Transient response and Analysis of R-L and R-C Circuit using Matlab/Simulink.	2	L2 (Understand)	PO1, PO5
2.	Transient response and Analysis of R-L-C Series Circuit using Matlab/Simulink.	2	L2 (Understand) L3 (Apply)	PO1, PO5
3.	Transient response and Analysis of R-L-C Parallel Circuit using Matlab/Simulink.	2	L2 (Understand) L3 (Apply)	PO1, PO5
4.	Characteristics analysis of R-L-C series Resonant circuit using Matlab/Simulink.	2	L2 (Understand) L3 (Apply)	PO1, PO5
5.	Characteristics analysis of R-L-C parallel Resonant circuit using Matlab/Simulink.	2	L2 (Understand) L3 (Apply)	PO1, PO5

6.	Verifications of Network Theorems-Thevenins, Superposition and Maximum Power Transfer theorems using Matlab/Simulink.	2	L3 (Apply) L4 (Analyze)	PO1, PO2, PO5
7.	Determination of Impedance and Admittance Parameters of Two-Port Network using Matlab/Simulink.	2	L3 (Apply) L4 (Analyze)	PO1, PO2,PO5
8.	Generations of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse and Ramp Signals Using MATLAB.	2	L2 (Understand) L3 (Apply)	PO1, PO2 PO5
9.	Representation of Poles and Zeros in S-Plane, Determination of partial fraction expansion in S-Domain and cascade connection of second order systems using MATLAB.	2	L3 (Apply) L4 (Analyze)	PO1, PO3

Course Outcomes:

1. Students will be able to design and analyze series and parallel resonating and transient Circuits and also they will be able in mesh current analysis.
2. Students will be able in node voltage analysis of a circuit and they will be able to apply different network theorems for finding branch currents and node voltages of practical circuits.
3. Students will be able to analyze basics signal generations and also they will be able to determine Poles and Zeros in S-Plane and also can determine partial fraction expansion in S-Domain and cascade connection of second order.
4. Students will be able to analyze a circuit using Laplace transformation and they will also learn the different two port parameters.

Learning Resources:

1. Laboratory manual provided from the organization.
2. a)Network Analysis by M.E. Van Valkenburg
   b)Network and Systems by D.Raychoudhary
3. MATLAB/Simulink
4. MATLAB/https://octave-online.net.

OEC381: Data Structures & Algorithms

Subject Name: Data Structures & Algorithms Credit: 2 Lecture Hours: 32
Subject Code: OEC381
Pre-requisite: Fundamentals of C Programming and
Engineering Mathematics

Relevant Links:

AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf
International Academia: https://ocw.mit.edu/courses/6-851-advanced-data-structures-spring-2012/pages/lecture-notes/

COURSE OBJECTIVES:

1. Understand the fundamentals of data structures and algorithms.
2. Familiarize the students with basic data structures and their use in fundamental algorithms.
3. Understand and design efficient algorithms for sorting and searching.
4. Be able to solve problem statements using algorithms.
5. Apply the skills to store and interpret data using defined structures and perform various operations.

COURSE OUTCOMES:

CO1: Students will be able to acquire and remember the knowledge of fundamental data structures.
CO2: Students will be able to understand any data structure properly and to have knowledge on basics of computer hardware and number systems.
CO3: Students will be able to implement any problem by writing their own algorithms.
CO4: Students will be able to analyze the algorithm for a given problem.
CO5: Students will be able to use different data structures and create/update basic data files.
CO6: Students will be able to learn various data structure approaches and techniques to develop and design projects.

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	Introduction to Data Structures in C programming	Algorithms; Functions and Recursion; Flowchart and pseudo-code; Time and Space complexity; Defining Data Structures; Arrays; 1D array, 2D array, multidimensional arrays; Operations in array	AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG1/ug-vol1.pdf International Academia: Lecture Notes | Advanced Data Structures | Electrical Engineering and Computer Science | MIT OpenCourseWare International Mapping: Hackerrank, TCS Codevita projects, GitHub platform. Dev C++ platform for coding will be used.	7	Assignment 1 • Write a C Program to Check Whether a Number is Prime or Composite. • Write a C Program to calculate GCD of two numbers. • Write a program to swap 2 numbers using call by value and call by reference. • Write a program to calculate n^m using recursion. • Write a C Program to print first 15 number of Fibonacci series. Assignment 2 • Write a program to create dynamically allocated array and find the 3 largest numbers. Write a program to input two matrices and then calculate the SUM and PRODUCT of their corresponding elements using dynamic memory allocation. • Write a program to merge two sorted arrays.

					• Determine if each input is a vowel. Save the nonvowel characters in a new array. • Write a program to transpose a matrix using malloc or calloc.

2	Linear Data Structures	Linked Lists; Singly linked list; Doubly linked list; Circular linked list; Stack; Queue	AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG1/ug-vol1.pdf International Academia: Lecture Notes | Advanced Data Structures | Electrical Engineering and Computer Science | MIT OpenCourseWare International Mapping: Hackerrank, TCS Codevita projects, GitHub platform. Dev C++ platform for coding will be used.	9	Assignment 3 • Write a program to implement integer singly linked list with the following primitives: create(); display(); insert_begin(); insert_end(); insert_pos(); delete_begin(); delete_end(); delete_pos(); • Merge two linked lists of same size with alternative elements without using a third list. • Write a function to insert a value in the new list at any position. • Write a program to count the number of occurrences of a given value in a linked list. • Write a program to form a linked list of floating point numbers. Display the sum and mean of these numbers. • Write a program to count the number of non-zero values in a circular linked list. Assignment 4

					• Write a program to implement a stack using a linked list. Assignment 5 • Write a program to implement a dequeue with the help of a linked list. • Write a program to create a queue from a stack. • Write a program to create a queue which permits insertion at any vacant location at the rear end.
3	Non-Linear Data Structures	Trees; Binary tree; Binary tree operations; Height and depth of B-Tree; Graphs; Definition and concepts; Types of graphs;	AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG1/ug-vol1.pdf International Academia: Lecture Notes | Advanced Data Structures | Electrical Engineering and Computer Science | MIT OpenCourseWare	9	Assignment 6 • Write a program to Print Height and Depth of Binary Tree. Assignment 7 • Write a program to implement

		Graph traversals - BFS, DFS; Shortest path	International Mapping: Hackerrank, TCS Codevita projects, GitHub platform. Dev C++ platform for coding will be used.		BFS and DFS algorithms.
4	Searching and Sorting	Hashing, Collision resolution techniques; Linear search, binary search, sequential search; Bubble sort, Insertion sort, Selection sort, Quick sort, Merge sort	AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG1/ug-vol1.pdf International Academia: Lecture Notes | Advanced Data Structures | Electrical Engineering and Computer Science | MIT OpenCourseWare International Mapping: Hackerrank, TCS Codevita projects, GitHub platform. Dev C++ platform for coding will be used.	7	Assignment 8 • Implement Linear probing collision resolution technique with the help of hashing in C programming. Assignment 9 • Write a program to create a binary search tree and perform all the operations. • Write a program to search and erase the duplicate values from a list. Assignment 10 • Write a program to Convert Sorted Array to Balanced binary search tree. • Write a program to implement Bubble sort and Selection sort in a linked list.

Suggested Learning Resources:

Text Books

1. “Data Structures Using C” by Reema Thareja.
2. “Data Structures” by S. Lipschutz.

Reference Books

1. “Data Structures And Program Design In C”, 2/E by Robert L. Kruse, Bruce P Leung.
2. “Data Structure Through C in Depth” by S.K. Srivastava and Deepali Srivastava; published by BPB Publications.
3. “Introduction to Algorithms” by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

OEC382: Python Programming Laboratory

Type of Course	Course Code	Course Name	L	T	P	Credit Points
Sessional	OEC382	Python Programming Laboratory	1	0	2	2

Course Objective:

Through this sessional hands-on Python programming lab, the students will be introduced the paradigm of Pyhton programming. They will learn basic concepts such as data handling, control flow, and relevant command structure for procedural and object-oriented programming. Additionally, these fundamental concepts of programming will lay the foundation for students and enable them to design solutions for real problems in the field of AI and Data Science data analysis.

Course Outcomes: After completion of this course students would be able to

CO1: Understand fundamental components of programming in python
CO2: Implement solutions using object orient programming concepts using python classes and objects
CO3: Develop databases, perform numerical computation and visualize data using python packages
CO4: Apply concepts of python to solve challenges in AI and Data Science.

Syllabus:

Module 1: Introduction to Python: The Python Interpreter, Console I/O, Conditions, Control Flow, Functions,

Module 2: Python Data Handling: Datatypes, List, Tuple, Set, Dictionaries, File I/O

Module 3: Object Oriented Programming with Python: Classes, Objects, Special Methods:

__init__, __call__, __iter__, __getitem__, __len__

Module 4: Numerical Data Analysis with Python: NumPy N-D arrays, Indexing, Slicing, Reshaping, ND-Array Arithmetic

Module 5: Database Handling with Python: Introduction to Pandas, Series, Dataframes, read CSV, read JSON

Module 6: Data Visualization: Introduction to Matplotlib: Pyplot, markers, lines, labels, grid, subplot, scatter, bars, histograms, pie-chart

Text Books:

(1) **Head First Python: A Learner's Guide to the Fundamentals of Python**

Programming, a Brain-Friendly Guide – (3rd edition, September 2023) - by Paul Barry (PUBLISHER: **O'Reilly book, Indian edition by SPD)**

(2) **Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter –**
(3rd edition, September 2022) – by Wes McKinney (PUBLISHER: **O'Reilly book, Indian edition by SPD)**

(3) **Introduction to Computation and Programming Using Python, third edition:**

With Application to Computational Modeling and Understanding Data Paperback –

(3rd edition, January 2021) – by John V. Guttag (PUBLISHER: **The MIT Press)**

Reference Books:

1) Python: The Complete Reference, Martin C. Brown, Osborne/McGraw-Hill
2) Python Crash Course, 3rd Edition: A Hands-On, Project-Based Introduction to Programming Paperback – (3rd edition, January 2023) – by Eric Matthes
3) Python for Everybody: Exploring Data in Python 3 – (October 2017) – by Charles Severance (Shrroff Publishers; First Edition (10 October 2017)

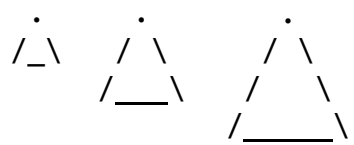
Alternate Courses:

NPTEL – Python for Data Science – Prof. Ragunathan Rengasamy, IIT Madras. https://nptel.ac.in/courses/106106212

COURSERA – Python for Data Science, AI & Development, Joseph Santarcangelo - https://www.coursera.org/learn/python-for-applied-data-science-ai

MIT MOOCS:
https://ocw.mit.edu/courses/6-0002-introduction-to-computational-thinking-and-data-science-fall-2016/

Laboratory/Practical: List of Experiments:

Mod	Wk	Ques	Problem Statements
1	1	1a	Write a program in python to calculate the area and perimeter of various polygons such as triangle, rectangles and circles.
		1b	Write a program in python to input 3 numbers separated by comma, and find the largest and smallest among them.
		1c	Write a program in python to find the roots of a quadratic equation using python.
		1d	Write a program in python to print all prime numbers inside a range of numbers provided by the user.
		1e	Write a program in python to print the mean and standard deviation of 5 scores input by the user.
	2	2a	Write a program in python to calculate the factorial of number
		2b	Write a program in python to calculate the Fibonacci sequence till a specific no. of terms
		2c	Write a program in python to calculate the factors of number
		2d	Write a program in python to count the number of words in a string
		2e	Write a program in python to calculate the magic square based on a given number
	3	3a	Print the series upto N terms: 1, 4, 9, 16, 25, 36…
		3b	Print the series upto N terms: 2, 4, 8, 16, 32, 64…
		3c	Print the series upto N terms: 1, 3, 7, 13, 21, 31 …
		3d	Print the series upto N terms: 1, 2, 4, 8, 16, 23, 28, 38, 49, 62 …
		3e	Print the series upto N terms: 1,2,6,24,120,720 …
	4	4a	Print the pattern upto N Lines: 

			N=2 N=3 N=4
		4b	Print a number as a 8 segment display N Lines:  N=2 N=3 N=4
		4c	Print the pattern upto N lines: 1 2 1 2 3 1 2 3 4 4 3 8 9 4 12 13 14 5 7 6 5 11 16 15 6 10 9 8 7 N=2 N=3 N=4
		4d	Print the following pattern upto N lines: 1 1 1 1 2 1 1 3 3 1 1 4 6 4 1 1 5 10 10 5 1 …

		4e	Print the shape for Height = N

			<table><tr><td>*** * * ***</td><td>**** * * * * ****</td><td>***** * * * * * * *****</td></tr><tr><td>N=3</td><td>N=4</td><td>N=5</td></tr></table>
	5	5a	Input a number and check whether a given number is prime or not using functions.
		5b	Input a number and check whether it is Armstrong or not using functions.
		5c	Input a number and check whether it is Krishnamurthy or not using functions.
		5d	Input a number and check whether the number is perfect or not using functions.
		5e	Write program in python to display reverse of a number using function.
2	**6**	6a	Write a program to Insert and Delete elements from list based on a given position
		6b	Find out Mean, Median and Mode of a list of numbers.
		6c	Sort a list of numbers without using a user defined function
		6d	Use a dictionary to count the frequency of words in a string input by the user.
		6e	Given a list of numbers return the indices in which a specific number occurs.
	7	7a	Write a program to create a text file as per the path and filename provided by the user and add text as input by the user.
		7b	Write a program to copy the content of a text file to another file but while copying convert all capital letters to small letters.

		7c	Create a text file to append N lines such that each line displays the Fibonacci sequence upto the term corresponding to specific line number separated by '-'. For N = 5 the text file should read. 1 1-1 1-1-2 1-1-2-3 1-1-2-3-5
		7d	Take input four values from user with respect to number of books, pens, bags and total price as follows. 36,116,23,4649 and save it as a text file Books: 36 Pens: 116 Bags : 23 Price : Rs. 4649
		7e	Write a program to create a dictionary by reading records from the text file output in program 7d. Dictionary : {"Books":36, "Pens": 116, "Bags":23, "Price": "4649"
		7f	Write a program to take inputs from user to create a dictionary for storing and displaying student data.
		7g	Store the dictionary data as a CSV file and write a function to display the data from the CSV file
		7h	Write a function to update or delete a specific record in student database csv file.

3	**8**	8a	Write a program to define a class “Box” and write functions to calculate its volume
		8b	Write a program to define a class “Car” and necessary functions to calculate the velocity given starting velocity (input), acceleration (member variable) and time of acceleration(input).
		8c	Write a program to define a class “Student”, and record the name and marks from a CSV file and display the grade card whenever the object is called as a function using call ().
		8d	Write a program to define a class “Loan” with member variables as principle, rate of interest and duration. Write a function to output the maturity amount.
		8e	Create a class that will return the Fibonacci numbers sequentially every time it is called using iter ()
		8f	Create a class “Data” that can store data points scattered in a 2-dimensional space and belonging to three different categories. Write a function to find the centroid of each category.
4	**9**	9a	Write a program to take input and display the values of 2 dimensional NumPy array
		9b	Write a program to add two 2-dimensional NumPy arrays
		9c	Write a program to transpose a 2-dimensional NumPy array
		9d	Write a program to reshape a 2-dimensional NumPy array.
		9e	Write a program to find the dot-product and matrix-product of two NumPy arrays.
		9f	Write a program to find the inverse of a NumPy matrix
		9g	Write a program to calculate the Eigen value and Eigen vectors of NumPy array
		9h	Write a program to find the determinant of NumPy matrix
		9i	Write a program using numpy to solve a system of linear equations
		9j	Write a program using numpy to perform singular value decomposition of a matrix.
5	**10**	10a	Read a CSV file as a pandas dataframe
		10b	Fetch rows from the dataframe based on a specific attribute
		10c	Display the value of specific columns of a pandas dataframe
		10d	Find the mean and standard deviation of a specific column containing numeric data.

		10e	Save the dataframe as a JSON file
		10f	Use pandas and yfinance to read a stock market data as a series.
6	**11**	11a	Write a program using matplotlib to display a line plot
		11b	Write a program using matplotlib to display a scatter plot
		11c	Write a program using matplotlib to display sine wave with frequency and amplitude input by the user
		11d	Write a program to display bar-plot and histogram.
		11e	Display 4 plots as 2x2 grid using the subplot function
		11f	Write a program to plot the stock prices as computed in Ques. No. 10f.