SPHOORTHY ENGINEERING COLLEGE
(UGC AUTONOMOUS)

B.Tech. in ELECTRONICS AND COMMUNICATION ENGINEERING
COURSE STRUCTURE & SYLLABUS (R25 Regulations)
Applicable from AY 2025-26 Batch

II YEAR I SEMESTER

S.No.	Course Code	Course Title	L	T	P	Credits
1.	S25EC301PC	Probability Theory and Stochastic Processes	3	0	0	3
2.	S25EC302PC	Signals and Systems	3	0	0	3
3.	S25EC303PC	Electronic Devices and Circuits	3	0	0	3
4.	S25EC304PC	Digital Logic Design	3	0	0	3
5.	S25EC305PC	Control Systems	2	0	0	2
6.	S25MS306HS	Innovation and Entrepreneurship	2	0	0	2
7.	S25EC307PC	Modelling and Simulation Lab	0	0	2	1
8.	S25EC308PC	Electronic Devices and Circuits Lab	0	0	2	1
9.	S25EC309PC	Digital Logic Design Lab	0	0	2	1
10.	S25EC310SD	Basics of Design Thinking and 3D Printing	0	0	2	1
11.	S25VA300ES	Environmental Science	1	0	0	1
		Total Credits	**17**	**0**	**08**	**21**

II YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1.	S25MA401BS	Numerical Methods and Complex Variables	3	0	0	3
2.	S25EC402PC	Electromagnetic Fields and Transmission Lines	3	0	0	3
3.	S25EC403PC	Analog and Digital Communications	3	0	0	3
4.	S25EC404PC	Electronic Circuit Analysis	3	0	0	3
5.	S25EC405PC	Linear and Digital IC Applications	3	0	0	3
6.	S25MA406PC	Computational Mathematics Lab	0	0	2	1
7.	S25EC407PC	Analog and Digital Communications Lab	0	0	2	1
8.	S25EC408PC	Electronic Circuit Analysis Lab	0	0	2	1
9.	S25EC409PC	Linear and Digital IC Applications Lab	0	0	2	1
10.	S25EC410SD	PCB Design and Prototyping	0	0	2	1
11.		**Total Credits**	**15**	**0**	**10**	**20**

SPHOORTHY ENGINEERING COLLEGE
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S25EC301PC: PROBABILITY THEORY AND STOCHASTIC PROCESSES

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Pre-requisite: Mathematics

Course Objectives:

1. To understand the fundamentals of probability and random variables.
2. To perform operations on random variables and analyze their properties.
3. To study multiple random variables and their statistical relationships.
4. To analyze the temporal characteristics of random processes.
5. To understand noise sources and their representation in communication systems.

Course Outcomes: Upon completing this course, the student will be able to

1. Apply concepts to perform operations on single and multiple random variables.
2. Analyze the temporal characteristics of random processes.
3. Describe the spectral properties of random signals.
4. Evaluate the response of LTI systems using autocorrelation (ACF) and power spectral density (PSD).
5. Explain noise concepts and their role in communication systems.

Course Articulation Matrix:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	–	2	–	–	–	–	–	–	–	3	1	–
CO2	3	3	–	2	–	–	–	–	–	–	–	3	1	–
CO3	3	3	–	2	–	–	–	–	–	–	–	3	2	–
CO4	3	3	2	3	1	–	–	–	1	–	–	3	2	1
CO5	3	3	2	2	1	1	–	–	1	1	–	3	2	2

UNIT - I

Probability: Probability introduced through Sets and Relative Frequency: Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Joint Probability, Conditional Probability, Total Probability, Bay's Theorem, Independent Events.

Random Variables- Definition, Conditions for a Function to be a Random Variable, Discrete, Continuous and Mixed Random Variable, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Methods of defining Conditioning Event, Conditional Distribution, Conditional Density and their Properties.

UNIT - II

Operations on single Random Variable

Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Chebychev's Inequality, Characteristic Function, Moment Generating Function, Transformations of a Random Variable - Monotonic and Non-monotonic Transformations of Continuous and Discrete Random Variable, Computer generation of a Random Variable of a given PDF/CDF.

UNIT - III

Multiple random variables and Operations on Multiple random variables: Vector Random Variables, Joint Distribution Function and its Properties, Marginal Distribution Functions, Conditional Distribution and Density– Point and Interval conditioning, Statistical Independence, Sum of Two and more Random Variables, Central Limit Theorem, Equal and Unequal Distribution (Proof not expected).

Expected Value of a Function of Random Variables- Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variable case, Properties, Transformations of Multiple Random Variables, Linear

Transformations of Gaussian Random Variables.

UNIT IV

Random processes – Temporal characteristics: The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second- Order and Wide- Sense Stationarity, (N-Order) and Strict-Sense Stationarity, Time Averages and Ergodicity, Mean- Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function and Its Properties, Cross-Correlation Function and Its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process. Random Signal Response of Linear Systems: System Response — Convolution, Mean and Mean-squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output.

UNIT V

Random processes – Spectral characteristics: The Power Spectrum: Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function. Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output.

Noise sources: Resistive / Thermal Noise Source, Arbitrary Noise Sources, Effective Noise Temperature, Noise equivalent bandwidth, Average Noise Figures, Average Noise Figure of cascaded networks, Narrow Band noise, Quadrature representation of narrow band noise & its properties.

TEXT BOOKS:

1. Peyton Z. Peebles - Probability, Random Variables & Random Signal Principles - TMH, 4th Edition
2. Murray R Spiegel, John Schiller, R Alu Srinivasan. – Probability and Statistics – Schaum's Outlines, 2nd Edition, TMH

REFERENCES:

1. P Ramesh Babu - Probability Theory and Random Processes – McGraw Hill Education
2. Athanasios Papoulis and S. Unnikrishna Pillai - Probability, Random Variables and Stochastic Processes – McGraw Hill Education, 4th Edition
3. K. N. Hari Bhat, K. Anitha Sheela and Jayant Ganguly - Probability Theory and Stochastic Processes for Engineers - Pearson, 1st Edition, 2011
4. Taub and Schilling - Principles of Communication systems by (TMH), 2008
5. Y Mallikarjuna Reddy - Probability Theory and Stochastic Processes, 4th Edition, University Press

SPHOORTHY ENGINEERING COLLEGE
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S25EC302PC: SIGNALS AND SYSTEMS

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: Mathematics

Course Objectives: The objectives of this subject are to:

1. Classify different types of signals and systems.
2. Analyze signals in time and frequency domains.
3. Explain distortionless transmission through LTI systems.
4. Apply convolution and correlation in signal analysis.
5. Use Laplace transform, Z-transform, and sampling concepts for analyzing signals.

Course Outcomes: Upon completing this course, the student will be able to:

1. Classify different types of signals and systems.
2. Analyze signals in time and frequency domains using transform techniques.
3. Identify conditions for signal transmission and physical realization of systems.
4. Apply sampling theorem for baseband and bandpass signals.
5. Explain correlation and power spectral density (PSD) and their applications.

Course Articulation Matrix:

COs \ POs/PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	1	-	-	-	3	-	-
CO2	3	3	-	2	2	-	-		-	-	-	3	2	-
CO3	3	3	2	2	-	-	-		-	-	-	3	2	-
CO4	3	2	2	2	2	1	-	1	1	-	-	3	2	2
CO5	3	3	-	2	2	1	-	1	-	1	1	3	2	-

UNIT - I

Signal Analysis: Analogy between Vectors and Signals, Orthogonal Signal Space, Signal approximation using Orthogonal functions, Mean Square Error, Closed or complete set of Orthogonal functions, Orthogonality in Complex functions, Classification of Signals and systems, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function.

UNIT - II

Fourier series: Representation of Fourier series, Continuous time periodic signals, Pr operties of Fourier Series, Dirichlet's conditions, Trigonometric Fourier Series and Exponential Fourier Series, Complex Fourier spectrum.

Fourier Transforms: Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signal, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of Fourier Transform, Fourier Transforms involving Impulse function and Signum function, Introduction to Hilbert Transform.

UNIT - III

Signal Transmission through Linear Systems: Linear System, Impulse response, Response of a Linear System, Concept of convolution in Time domain and Frequency domain, Graphical representation of Convolution. Extraction of Signal from Noise by Filtering. Linear Time Invariant (LTI) System, Linear Time Variant (LTV) System, Transfer function of a LTI System, Filter characteristic of Linear System, Distortion less transmission through a system, Signal bandwidth, System Bandwidth, Ideal LPF, HPF, and BPF characteristics, Causality and Paley-Wiener criterion for physical realization, Relationship between Bandwidth and risetime. Extraction of Signal from Noise by Filtering.

UNIT - IV

Laplace Transforms: Laplace Transforms (L.T), Inverse Laplace Transform, Concept of Region of Convergence (ROC) for Laplace Transforms, Properties of

L.T, Relation between L.T and F.T of a signal, Laplace Transform of certain signals using waveform synthesis.

Correlation: Auto Correlation and Cross Correlation Functions, Relation between Convolution and Correlation, Properties of Correlation Functions, Energy Density Spectrum, Power Density Spectrum, Relation between Autocorrelation Function and Energy/Power Spectral Density Function, Parseval's Theorem, Detection of Periodic Signals in the presence of Noise by Correlation.

UNIT - V

Sampling theorem: Graphical and analytical proof of Sampling Theorem for Base band/Band Limited and Band Pass Signals, Types of Sampling: Impulse Sampling, Natural and Flattop Sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing,

Z–Transforms: Concept of Z- Transform of a Discrete Sequence, Distinction between Laplace, Fourier and Z Transforms, Region of Convergence in Z-Transform, Constraints on ROC for various classes of signals, Inverse Z-transform, Properties of Z-transforms.

TEXT BOOKS

1. Signals, Systems & Communications -B.P. Lathi, BS Publications.
2. Signals and Systems – Allan. V. Oppenheim, Allan. S. Willsky with S. Hamid. Nawab, 2nd Ed. Pearson.

REFERENCE BOOKS

1. Signals and Systems–Simon Haykin, Barry Van Veen, 2nd Ed., Wiley.
2. Signals and Systems – A. Rama Krishna Rao, 2008, TMH.
3. Fundamentals of Signals and Systems – Michel J. Roberts, Govind Sharma, 2nd Ed., MGH.
4. Signals, Systems and Transforms - Charles. L. Philips, John M. Parr and Eve A. Riskin, 4th Ed., 2004, Pearson, Prentice Hall.

SPHOORTHY ENGINEERING COLLEGE
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S25EC303PC: ELECTRONIC DEVICES AND CIRCUITS

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives

1. To understand the fundamentals of semiconductor devices such as diodes, BJTs, and FETs.
2. To analyze the characteristics and operation of electronic devices in different configurations.
3. To design and evaluate basic electronic circuits including rectifiers, biasing circuits, and amplifiers.
4. To develop the ability to model and analyze small-signal transistor circuits.
5. To introduce modern semiconductor devices and compare their performance with conventional technologies.

Course Outcome

1. Explain diode characteristics and use them in rectifier, clipping, and clamping circuits.
2. Describe the working of BJTs and analyze their behavior in different configurations.
3. Design BJT biasing circuits and determine a stable operating point.
4. Analyze transistor amplifiers using basic models and evaluate their performance.
5. Explain the working of FETs and advanced devices (FinFETs, CNTFETs) and compare their features.

Course Articulation Matrix:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	-	-	-	-	-	3	1	-
CO2	3	3	2	2	1	-	-	-	-	-	-	3	1	-
CO3	3	3	3	2	1	-	-	-	-	-	-	3	2	1
CO4	3	3	3	2	2	-	-	-	-	-	1	3	2	1
CO5	3	3	2	2	2	1	2	-	-	-	2	2	3	2

UNIT - I:

Diode Characteristics and Applications: PN junction diode – I-V characteristics, Diode resistance and capacitance, Diode models (Ideal, Simplified, Piecewise Linear), Rectifiers — Half-wave, Full- wave (Center-tap and bridge), Capacitor filter for rectifiers, Clippers and clampers, Zener diode – I-V characteristics and voltage regulation.

UNIT - II:

Bipolar Junction Transistor (BJT): Structure and working principle of BJT, Current components and transistor action, Configurations: Common Base (CB), Common Emitter (CE), Common Collector (CC), Input and output characteristics, Determination of h-parameters from transistor characteristics.

UNIT - III:

BJT Biasing: Need for biasing and stabilization, Load line and operating point, Biasing techniques: Fixed bias, Collector-to-base bias, Voltage divider bias, Stability factors and thermal runaway

UNIT - IV:

Transistor Amplifiers: Transistor as a small-signal amplifier, h-parameter equivalent circuit, CE, CB, CC amplifier analysis using h-parameters, Approximate CE model – with and without emitter bypass capacitor.

UNIT - V:

Special Purpose Diodes: Principle of Operation of — SCR, Tunnel Diode, Varactor Diode, Photo Diode, Solar Cell, LED and Schottky Diode

Field Effect Transistors and Advanced Devices: JFET: Structure, operation, and characteristics, MOSFET: Enhancement and Depletion modes — Structure, operation, and characteristics, Advanced Devices: FinFETs - 3D structure, Scaling advantages, CNTFETs - Structure, ballistic transport, fabrication, Comparison: CMOS vs. FinFET vs. CNTFET.

TEXT BOOKS:

1. Millman, Jacob, and Christos C. Halkias. *Electronic Devices and Circuits*. Tata McGraw-Hill, 1991.
2. Salivahanan, S., and N. Suresh Kumar. *Electronic Devices and Circuits*. McGraw-Hill Education, 4th ed., 2017.

REFERENCE BOOKS:

1. Bell, David A. *Electronic Devices and Circuits*. Oxford University Press, 5th ed., 2008.
2. Neamen, Donald A. *Electronic Circuit Analysis and Design*. McGraw-Hill, 2nd ed., 2001.
3. Razavi, Behzad. *Fundamentals of Microelectronics*. Wiley, 2nd ed., 2013.
4. Taur, Yuan, and Tak H. Ning. *Fundamentals of Modern VLSI Devices*. Cambridge University Press, 2nd ed., 2009.
5. Boylestad, Robert L., and Louis Nashelsky. *Electronic Devices and Circuit Theory*. Pearson, 11th ed., 2013.
6. Sedra, Adel S., and Kenneth C. Smith. *Microelectronic Circuits*. Oxford University Press, 7th ed., 2014.

SPHOORTHY ENGINEERING COLLEGE
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S25EC304PC: DIGITAL LOGIC DESIGN

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives

1. To understand the basic concepts of Boolean algebra and logic simplification techniques.
2. To design and analyze combinational logic circuits using standard logic gates.
3. To study the working of memory elements like latches and flip-flops.
4. To develop skills in designing synchronous sequential circuits.
5. To introduce programmable logic devices and their role in digital system design.

Course Outcomes (Refined & Simple)

1. Simplify Boolean expressions using algebraic and minimization techniques.
2. Design combinational logic circuits using basic logic gates.
3. Explain the operation of latches and flip-flops and analyze sequential circuits.
4. Design synchronous sequential circuits using flip-flops and logic gates.
5. Apply programmable logic devices to implement digital systems.

Course Articulation Matrix

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	3	1	-
CO2	3	2	3	-	1	1	-	-	-	-	-	3	2	-
CO3	3	3	2	1	-	-	-	-	-	-	1	3	2	1
CO4	3	3	3	2	1	-	-	-	1	-	1	3	2	2
CO5	2	2	2	1	3	-	-	-	-	-	2	2	3	3

UNIT – I:

Number Systems: Binary, Octal, Decimal, Hexadecimal, Fixed-point and Floating-point Number Representations, Complements of Numbers: 1's and 2's Complement, Error Detection and Correction Codes: Parity Check, Hamming Code.

Boolean Algebra and Logic Gates: Axiomatic definitions, basic theorems and properties, Boolean Functions: Canonical and standard forms, Digital Logic Gates Overview.

UNIT - II:

Gate-Level Minimization Techniques: Karnaugh maps: 2, 3, and 4 variables, Sum-of-products (SOP) and product-of-sums (POS) simplification, Don't care conditions, Implementation using NAND and NOR gates.

UNIT - III:

Combinational Logic Circuits: Analysis and design procedures, Binary adder-subtractor and BCD adder, magnitude comparator, decoders, encoders, multiplexers and demultiplexers.

UNIT - IV:

Sequential Logic Circuits: Gated latches, Flip-flops: Clocked S-R, D, T, JK, Master-Slave JK, Design of synchronous and asynchronous counters, Shift registers: types and applications.

UNIT - V:

Synchronous Sequential Logic Moore and Mealy state machines, State diagrams, state tables, and state reduction, Case studies: sequence detector, traffic light controller, vending machine.

Programmable Logic Devices: Memory devices - RAM, ROM, Programmable Logic Arrays (PLA), Programmable Array Logic (PAL)

TEXT BOOK:

1. M. Morris Mano, Michael D. Ciletti, *Digital Design with an Introduction to the Verilog HDL*, 6th Edition, Pearson Education/PHI, 2017.

REFERENCE BOOKS:

1. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, *Digital Systems: Principles and Applications*, 10th Edition, Pearson Education.
2. Charles H. Roth Jr., Larry L. Kinney, *Fundamentals of Logic Design*, 6th Edition, Cengage Learning.

SPHOORTHY ENGINEERING COLLEGE
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S25EC305PC: CONTROL SYSTEMS

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Pre-Requisites: Linear Algebra and Calculus, Ordinary Differential Equations and Multivariable Calculus Laplace Transforms, Numerical Methods and Complex variables

Course Objectives:

1. To understand the basic concepts and classifications of control systems.
2. To develop mathematical models of mechanical and electrical systems using block diagrams and signal flow graphs.
3. To analyze control system performance in time and frequency domains.
4. To design controllers and compensators to improve system performance.
5. To apply state-space techniques for analyzing system properties like controllability and observability..

Course Outcomes: Upon completion of this Course, the students will be able to:

1. Describe open- and closed-loop systems, and develop mathematical models using block diagrams and signal flow graphs.
2. Analyze time response of second-order systems using time-domain specifications, and assess stability using Routh-Hurwitz criterion and root locus techniques.
3. Analyse frequency response plots including Bode, Polar, and Nyquist plots, and investigate system stability.
4. Design compensators and controllers to meet specific performance criteria in control systems.
5. Apply the state-variable approach and analyze controllability and

observability.

Course Articulation Matrix:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	3	1	-
CO2	3	3	2	1	1	-	-	-	-	-	-	3	2	1
CO3	3	3	2	1	1	-	-	-	-	-	-	3	2	1
CO4	3	3	3	2	1	-	-	-	-	-	-	3	2	2
CO5	3	3	2	1	1	-	-	-	-	-	-	3	3	2

UNIT - I

Control System fundamentals: Classification of control systems, Open and Closed loop systems. Mathematical modelling of mechanical systems and their conversion into electrical systems. Block diagram reduction and Signal flow graphs.

UNIT - II

Time response Analysis: Transfer function and Impulse response, types of input. Transient response of second order system for step input. Time domain specifications. Types of systems, static error coefficients, Routh - Hurwitz criterion for stability.

Root locus techniques: Analysis of typical systems using root locus techniques. Effect of location of roots on system response.

UNIT - III

Frequency response Analysis: Frequency domain specifications, bode plots, Gain margin and Phase Margin. Polar plot, Nyquist plot, and Nyquist criterion for stability.

UNIT - IV

Compensators and controllers: Introduction to compensators, Lag compensator, Lead compensator, Lag- Lead compensator, Design of compensators using bode plot. Introduction to controllers, P, I, D, PI, PD, PID controllers.

UNIT - V

State space representation: Concept of state and state variables. State models of linear time invariant systems, State transition matrix, Solution of state equations. Controllability and observability.

TEXT BOOKS:

1. I.J. Nagrath and M. Gopal, Control System Engineering, 5ed., New Age Publishers, 2009.
2. A. Nagoor Kani, Control Systems, 2ed., RBA Publications, 2007.

REFERENCE BOOKS:

1. K. Ogata, Modern Control Engineering, 2ed., Prentice Hall, 2010.
2. M. Gopal, Control Systems: Principles and Design, Tata McGraw-Hill, 1997.
3. Norman S. Nise, Control Systems Engineering, 5ed., John Wiley & Sons, 2007.
4. A.K. Jairath, Solutions and Problems of Control Systems, CBS Publishers, 2013.
5. Benjamin C. Kuo, Automatic Control Systems, 7ed., PHI, 2010.

SPHOORTHY
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S25MS306HS: INNOVATION AND ENTREPRENEURSHIP

B.Tech. II Year I Sem.

L	T	P	C
2	0	0	2

Course Objectives:

1. To familiarize on the basic concepts of innovation, entrepreneurship and its importance.
2. To Identify and analyze the process of problem-opportunity identification, market segmentation, and idea generation techniques.
3. To initiate prototype development and understand minimum viable product.
4. To develop initial Business and financial planning and Go-to-Market strategies
5. To impart knowledge on establishing startups, venture pitching and IPR

Course Outcomes:

1. Understand the entrepreneurship and the entrepreneurial process and its significance in economic development.
2. Assess the problem from an industry perspective and generate solutions using the design thinking principles.
3. Assess market competition, estimate market size, and develop a prototype.
4. Analyze Business and financial planning models and Go-to-Market strategies.
5. Able to build a start-up, register IP and identify funding opportunities.

Course Articulation Matrix

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	–	–	2	–	2	–	1	1	1	1	2
CO2	2	3	3	2	2	2	1	–	2	2	2	2	2	3
CO3	2	3	3	2	3	–	1	–	2	2	2	2	3	3
CO4	1	2	3	1	2	2	–	2	2	3	3	1	2	2
CO5	1	2	2	–	1	3	1	3	2	3	3	1	1	2

Unit I: Fundamentals of Innovation and Entrepreneurship

Innovation: Introduction, need for innovation, Features, Types of innovations, innovations in manufacturing and service sectors, fostering a culture of innovation, planning for innovation.

Entrepreneurship: Introduction, types of entrepreneurship attributes, mindset of entrepreneurial and intrapreneurial leadership, Role of entrepreneurs in economic development. Woman Entrepreneurship, Importance of on-campus startups. Understanding to build entrepreneurial mindset, attributes and networks individuals while on campus.

Core Teaching Tool: Simulation, Game, Industry Case Studies (Personalized for students — 16 industries to choose from), Venture Activity.

Unit II: Problem and Customer Identification

Identification of gap, problem, analyzing the problem from a industry perspective, real-world problems**,** market and customer segmentation, validation of customer problem fit, Iterating problem-customer fit, Competition and Industry trends mapping and assessing initial opportunity, Porter's Five Force Model. Idea generation, Ideation techniques: Brainstorming, Brain writing, Round robin, and SCAMPER, Design thinking principles, Mapping of solution to problem.

Core Teaching Tool: Several types of activities including: Class, game, Gen AI, 'Get out of the Building' and Venture Activity.

Unit III: Opportunity assessment and Prototype development

Identify and map global competitors, review industry trends, and understand market sizing: TAM, SAM, and SOM. Assessing scope and potential scale for the opportunity.

Understanding prototyping and Minimum Viable Product (MVP). Developing a prototype: Testing, and validation.

Core Teaching Tool: Venture Activity, no-code Innovation tools, Class activity

Unit IV: Business & Financial Models

Introduction to Business Model and types, Lean Canvas Approach: 9-block lean canvas model, building lean canvas for your startup. Business planning: components of Business plan- Sales plan, People plan and financial plan, Financial Planning: Types of costs, preparing a financial plan for profitability using a financial template, understanding the basics of Unit economics, Economies of Scale and analyzing financial performance. Go-To-Market (GTM) approach – Selecting the RightChannel, creating digital presence, and building customer acquisition strategy.

Core Teaching Tool: Founder Case Studies – Sama and Securely Share; Class activity and discussions; Venture Activities.

Unit V: Startups and IPR

Startup requirements, building founding team members and mentors, pitch preparation, start-up registration process, funding opportunities and schemes, institutional support to entrepreneurs, startup lifecycle, documentation, legal aspects in startup, venture pitching readiness, National Innovation Startup Policy (NISP) and its features.

Patents, Designs, Patentability, Procedure for grants of patents. Indian Scenario of Patenting, International Scenario: International cooperation on Intellectual Property. Patent Rights: Scope of Patent Rights. Copyright, trademark, and GI. Licensing and transfer of technology.

Core Teaching Tool: Expert talks; Cases; Class activity and discussions; Venture

Activities.

Suggested Readings:

1. John R Bessant, Joe Tidd, Innovation and Entrepreneurship, 4E, Wiley, Latest Edition.
2. Ajay Batra, The Stratup Launch Book- A Practical Guide for Launching Customer Centric Ventures, Wiley, 2020. (For Core Teaching Tool).
3. Entrepreneurship Development and Small Business Enterprises, Poornima M Charantimath, 3E, Pearson, 2018.
4. D.F. Kuratko and T.V. Rao, Entrepreneurship: A South-Asian Perspective, Cengage Learning, 2013.
5. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition.
6. NISP -Brochure inside pages - startup_policy_2019.pdf

SPHOORTHY ENGINEERING COLLEGE
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S25EC307PC: MODELLING & SIMULATIONLAB

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Note:

- All the experiments are to be simulated using MATLAB or equivalent software
- Minimum of 12 experiments are to be completed / simulated.

Course Objectives (Lab)

1. To familiarize students with simulation tools for analysis of signals and systems in time and frequency domains.
2. To enable analysis and characterization of continuous and discrete-time systems including sampling concepts.
3. To provide hands-on experience in generating and analyzing random signals and noise processes.
4. To apply simulation tools for modeling and analysis of control systems using platforms like Simulink.
5. To develop skills in interpreting simulation results and solving real-world engineering problems.

Course Outcomes (COs)

Upon completion of the lab, students will be able to:

1. Generate and analyze signals and sequences in time and frequency domains using simulation tools.
2. Analyze and characterize continuous-time and discrete-time systems, including sampling techniques, using simulation tools.
3. Generate random signals and evaluate their statistical properties such as moments and apply noise reduction techniques.

4. Model and analyze control systems using simulation tools such as Simulink.
5. Interpret simulation results to solve engineering problems and validate system performance.

Course Articulation Matrix:

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	2	2	3	3	1	–	–	2	1	–	3	3	2
CO2	3	3	3	3	3	1	–	–	2	1	–	3	3	2
CO3	3	2	2	3	3	1	–	–	2	1	–	3	3	2
CO4	3	2	3	3	3	2	–	–	2	1	1	3	3	3
CO5	3	3	2	3	3	2	–	–	2	2	1	3	3	2

List of Experiments:

Signals and Systems (Minimum 7 Experiments)

1. **Signal Generation & Operations**
   How can standard signals (impulse, step, ramp, sinusoidal, square, triangular, etc.) be represented and compared? Generate these signals and examine how operations like shifting, scaling, folding, addition, and multiplication affect them. Also, determine their energy and average power.
2. **Signal Decomposition**
   Why is it useful to express a signal in terms of even and odd components? Decompose a given signal into even and odd parts, and identify its real and imaginary components.
3. **System Output & Correlation**
   How does a system respond to different inputs, and why is impulse response important? Determine the output for a given input and impulse response, and analyze signals using autocorrelation and cross-correlation.
4. **System Properties**
   Why are properties like linearity, time invariance, stability, and realizability

important? Examine a given system and verify whether it satisfies these properties.

5. **System Response Analysis**
   How do impulse and sinusoidal inputs help in understanding system behavior? Obtain system responses and represent them using real & imaginary plots, as well as magnitude & phase plots.
6. **Fourier Transform Analysis**
   Why is the Fourier Transform useful in signal analysis?
   Determine the Fourier Transform of a signal and analyze its magnitude and phase spectrum.
7. **Laplace Transform & S-Plane**
   How does the Laplace Transform help in analyzing continuous-time systems? Determine the transform, plot magnitude and phase, and represent the system using a pole-zero diagram in the S-plane.
8. **Z-Transform & Z-Plane**
   How is the Z-Transform useful for discrete-time analysis? Determine the transform, plot magnitude and phase, and represent the system using a pole-zero diagram in the Z-plane.
9. **System Modeling using Simulink**
   How can simulation tools help in understanding dynamic systems? Model systems to solve differential equations and analyze the response of an RLC circuit for different inputs and initial conditions.
10. **Gibbs Phenomenon**
    Why does Gibbs phenomenon occur in signal approximation? Demonstrate and analyze it using waveform synthesis.

Probability & Stochastic Processes (Minimum 3 Experiments)

1. **Random Variables**
   What role do probability distributions play in signal modeling? Generate random variables with different PDFs and CDFs and analyze their behavior.

2. **Gaussian Noise Analysis**
   Why is Gaussian noise widely used in communication systems? Generate Gaussian noise and evaluate its statistical properties such as mean, skewness, kurtosis, PDF, and PSD.
3. **Sampling Theorem**
   Why is proper sampling important in digital signal processing? Verify the sampling theorem using different sampling rates and observe sampled and reconstructed signals.
4. **Noise Removal**
   How can unwanted noise be reduced in signals? Apply cross-correlation techniques to remove noise and observe the improvement.
5. **Signal Extraction**
   How can hidden periodic signals be detected in noisy environments? Use autocorrelation to extract periodic components masked by noise.

Control Systems (Minimum 2 Experiments)

1. **DC Motor Modeling**
   How can the behavior of a DC motor be represented and studied? Build and simulate a DC motor model and analyze its response.
2. **PID Controller**
   Why is a PID controller widely used in control systems? Implement a PID controller and study the effect of its parameters on system performance.
3. **Controllability & Observability**
   What do controllability and observability indicate about a system? Analyze these properties for a given system.
4. **Root Locus**
   How does root locus help in understanding system stability? Generate and interpret root locus plots.
5. **Frequency Response**
   What insights do Bode and Nyquist plots provide? Generate these plots and analyze system behavior and stability.

Note: For the experiments with code/scripts written in MATLAB or equivalent (1-8, 11-15), the student can design a user interface or app using MATLAB App Designer or equivalent.

Application on Real Time signals

1. **GPS Signal Analysis**
   Why is autocorrelation important in GPS systems? Generate and analyze GPS signals, observe autocorrelation, and study their spectrum.

   For exact steps, go through the following page: https://www.mathworks.com/help/satcom/ug/gps-waveform-generation.html

2. **Speech Signal Sampling**
   How does sampling affect real-world signals like speech?
   Record a speech signal, vary the sampling rate, and observe aliasing effects.

   For steps, go through the following page:
   https://in.mathworks.com/help/matlab/import_export/record-and-play-audio.html
   https://in.mathworks.com/help/signal/ug/changing-signal-sample-rate.html

SPHOORTHY ENGINEERING COLLEGE (UGC AUTONOMOUS)

S25EC308PC: ELECTRONIC DEVICES AND CIRCUITS LAB

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Course Objectives

1. To understand the behavior of basic electronic devices through simulation and hardware experiments.
2. To analyze diode and rectifier circuits and their applications in electronic systems.
3. To study the characteristics and biasing of BJTs and their use in amplifiers.
4. To design and evaluate basic electronic circuits such as amplifiers and waveform shaping circuits.
5. To develop skills in using simulation tools and laboratory instruments for circuit analysis.

Course Outcomes (COs)

1. Perform simulation of electronic circuits and analyze their behavior.
2. Conduct hardware experiments on diodes and rectifier circuits and interpret results.
3. Analyze BJT characteristics and biasing techniques through experiments.
4. Design and evaluate amplifier and waveform shaping circuits.
5. Analyze FET/MOSFET characteristics and apply them in basic electronic circuits.

Course Articulation Matrix

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	-	-	-	-	-	-	2	3	1
CO2	3	2	2	2	1	-	-	-	-	-	-	3	1	-
CO3	3	3	2	2	1	-	-	-	-	-	-	3	2	1
CO4	3	3	3	2	2	-	-	-	-	-	1	3	2	2
CO5	3	2	2	2	3	-	-	-	-	-	1	3	3	2

A. Software-Based Simulation Experiments (Minimum 7)

1. **Rectifier Analysis**
   How do rectifiers convert AC to DC, and how can ripple be reduced? Simulate a full-wave bridge rectifier with a capacitor filter and analyze output waveform and ripple.
2. **Voltage Regulation using Zener Diode**
   How does a Zener diode maintain constant voltage under varying conditions? Simulate a Zener diode regulator and study its behavior with changes in input voltage and load.
3. **BJT Amplifier Performance**
   How does an emitter bypass capacitor affect amplifier gain? Simulate a common emitter amplifier with and without bypass capacitor and compare results.
4. **BJT as Switch and Amplifier**
   How can a transistor function both as a switch and an amplifier? Simulate BJT operation in both modes and observe differences in behavior.
5. **JFET Characteristics**
   How does a JFET control current flow? Simulate its characteristics and determine parameters like pinch-off voltage and transconductance.

6. **MOSFET and CMOS Logic**

   Why are MOSFETs widely used in digital circuits? Simulate MOSFET characteristics and design a CMOS inverter to study switching behavior.

7. **NMOS Characteristics**

   How does an enhancement-mode NMOS transistor operate? Simulate and analyze threshold voltage, drain current, and switching characteristics.

B. Hardware-Based Experiments (Minimum 7)

1. **PN Junction Diode Characteristics**

   How does a diode behave in forward and reverse bias? Plot I–V characteristics and determine cut-in voltage and resistance.

2. **Zener Diode as Voltage Regulator**

   How does a Zener diode regulate voltage in practical circuits? Observe its behavior under different input and load conditions.

3. **Rectifier Circuits**

   How do different rectifier configurations affect output? Design half-wave and full-wave rectifiers (center-tap and bridge) with/without filters and compare ripple and output voltage.

4. **Clipper and Clamper Circuits**

   How can waveforms be modified using diode circuits? Implement clipper and clamper circuits and observe waveform shaping.

5. **BJT Characteristics (CE Configuration)**

   How does a BJT behave in common emitter configuration? Plot input/output characteristics and determine gain and resistances.

6. **BJT Biasing Circuits**

   Why is biasing important for amplifier stability? Design fixed bias and voltage divider bias circuits and study the operating point and load line.

7. **BJT Configurations (CB, CE, CC)**

   How do different transistor configurations affect performance? Construct CB, CE, and CC circuits and compare their characteristics, gains, and resistances.

Software Requirements

- LTSpice
- Computer/Laptop (basic configuration)
- Virtual Labs (For Basics)

Hardware Requirements

- DC Power Supply (0–30V)
- Function Generator
- Digital Multimeter
- CRO/DSO
- Breadboard and wires
- Basic components (Resistors, Capacitors, Diodes, BJTs, FETs)
- Trainer kits (optional)

SPHOORTHY
ENGINEERING COLLEGE
(UGC AUTONOMOUS)

S25EC309PC: DIGITAL LOGIC DESIGN LAB

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Course Objectives

1. To understand the design and implementation of basic digital circuits using logic gates and ICs.
2. To develop skills in realizing combinational and sequential circuits in hardware.
3. To learn Verilog HDL for modeling and simulation of digital systems.
4. To analyze and design digital systems such as counters, shift registers, and FSMs.
5. To use modern simulation tools for verification and analysis of digital designs.

Course Outcomes (COs)

1. Implement and verify basic combinational logic circuits using hardware and simulation tools.
2. Design and analyze arithmetic and code conversion circuits.
3. Develop and simulate sequential circuits such as counters and shift registers.
4. Design digital systems using Verilog HDL with different modeling styles.
5. Apply digital design concepts to real-time applications like controllers and sequence detectors.

Course Articulation Matrix:

COs \ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	2	-	-	-	-	-	-	3	2	1
CO2	3	3	2	2	1	-	-	-	-	-	-	3	2	1
CO3	3	3	3	2	2	-	-	-	-	-	1	3	2	2
CO4	3	2	3	2	3	-	-	-	-	-	1	3	3	2
CO5	3	2	3	2	2	-	-	-	-	-	1	3	2	3

A. Verilog HDL-Based Simulation Experiments (Minimum 7)

1. **Comparator Design**
   How do digital systems compare binary numbers? Design and simulate a 2-bit comparator and extend it to 4-bit.
2. **Multiplexer Design**
   How does a multiplexer select inputs? Implement 2:1 and 8:1 multiplexers using different modeling styles.
3. **Decoder Design**
   How are binary inputs decoded? Design 2-to-4 and 3-to-8 decoders.
4. **Boolean Function Implementation**
   How can decoders realize logic functions? Implement a Boolean function using decoder-based design.
5. **Shift Register**
   How is data stored and shifted? Design a universal shift register.
6. **Synchronous Counter**
   How do synchronous counters work? Design a MOD-n counter.
7. **Asynchronous Counter**
   How does a ripple counter operate? Design and simulate a custom sequence counter.
8. **Sequence Detector (FSM)**
   How are patterns detected? Design a sequence detector using FSM.

B. Hardware-Based Experiments (Minimum 7)

1. **Boolean Function Realization**
   Implement simplified Boolean expressions using basic and universal gates.
2. **Arithmetic Circuits**
   Design half/full adders and subtractors.
3. **Universal Gates**
   Construct logic gates using only NAND/NOR gates.
4. **Parity & Majority Circuits**
   Design parity generators and majority logic circuits.
5. **Code Converters**
   Implement Binary–Gray, Gray–Binary, and BCD–Excess-3 converters.
6. **Combinational Circuits**
   Design multiplexer, comparator, and 7-segment decoder.
7. **Sequential Circuit**
   Design a traffic light controller using flip-flops.

Hardware Requirements

- Digital Trainer Kit (with power supply and clock)
- Logic ICs (7400, 7402, 7408, 7432, 7486, 7404, etc.)
- Flip-Flop ICs (7474, 7476)
- Multiplexer/Decoder ICs (74153, 74138, 74139)
- LEDs, switches, connecting wires

Software Requirements

- ModelSim
- Computer

SPHOORTHY ENGINEERING COLLEGE
(UGC AUTONOMOUS)

S25EC310SD: Basics of Design Thinking and 3D Printing

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Course Objectives

1. To introduce the fundamentals of Design Thinking and human-centered problem solving.
2. To develop skills in identifying user needs and generating innovative solutions.
3. To provide basic knowledge of 3D printing technologies, materials, and applications.
4. To enable students to design simple 3D models using tools like Fusion 360.
5. To apply design thinking and 3D printing concepts to develop prototypes for real-world problems.

Course Outcomes

Upon successful completion of the course, students will be able to:

1. Explain the stages of Design Thinking and apply them to simple problem-solving scenarios.
2. Identify user needs, define problems clearly, and generate multiple innovative ideas.
3. Describe different 3D printing technologies, materials, and their applications.
4. Design basic 3D models using CAD tools and prepare them for 3D printing.
5. Develop a prototype using design thinking principles and 3D printing to address a real-world problem.

Course Articulation Matrix:

CO \ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	1	–	2	2	2	1	2	–	1	1	2
CO2	2	3	3	2	1	2	2	1	2	2	1	2	2	3
CO3	2	2	2	1	2	1	2	–	1	1	–	2	2	2
CO4	2	2	3	2	3	1	1	–	2	2	1	2	3	3
CO5	2	3	3	3	3	2	2	2	3	3	3	2	3	3

UNIT–I: Design Thinking (Empathize, Define, Ideate, Prototype, Test), human-centered design, basics of sustainability (brief), simple case studies.

UNIT–II: User needs analysis, problem identification, writing problem statements, ideation techniques (brainstorming, mind mapping, SCAMPER), concept selection.

UNIT–III: Basics of 3D printing and additive manufacturing, types (FDM, SLA, SLS), materials (PLA, ABS, PETG), applications, basic workflow, eco-friendly practices (brief).

UNIT–IV: Fusion 360 basics, sketching, 3D modeling (extrude, revolve, sweep), assembly basics, file formats (STL, OBJ), design for 3D printing, simple practice models.

UNIT–V: 3D printer components, slicing software (Cura), printer setup, parameters (layer height, infill, supports), troubleshooting, rapid prototyping, testing, mini project (real-world problem).

Text Books:

1. Idris Mootee, *Design Thinking for Strategic Innovation*, Wiley
2. Ben Redwood et al., *The 3D Printing Handbook*, 3D Hubs

Reference Books:

1. Tim Brown, *Change by Design*, Harper Business
2. Gibson et al., *Additive Manufacturing Technologies*, Springer

L	T	P	C
1	0	0	1

SPHOORTHY
ENGINEERING COLLEGE
(UGC AUTONOMOUS)

S25VA300ES: ENVIRONMENTAL SCIENCE
B.Tech. II Year I Sem.

Course Objectives

1. To understand ecosystems and how they support life.
2. To learn about natural resources and their proper use.
3. To understand biodiversity and the need for its conservation.
4. To study environmental pollution and methods to control it.
5. To create awareness about environmental laws and global environmental issues.

Course Outcomes

1. Explain ecosystems, energy flow, and environmental balance.
2. Describe different natural resources and their sustainable use.
3. Understand biodiversity, its importance, and conservation methods.
4. Identify types of pollution and methods to control them.
5. Explain environmental laws, policies, and global environmental challenges.

Course Articulation Matrix:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	–	1	–	3	3	2	1	1	–	1	–	1
CO2	2	2	1	1	–	3	3	2	1	1	–	1	–	1
CO3	2	2	1	1	–	3	3	3	1	1	–	1	–	1
CO4	2	3	1	2	–	3	3	2	1	1	–	1	–	1
CO5	2	2	–	1	–	3	3	3	1	2	1	1	–	1

UNIT – I: Ecosystems

Meaning and importance of ecosystems,Types, structure, and functions ,Food chain, food web, ecological pyramids,Energy flow and cycles (water, carbon, etc.) ,Bioaccumulation and biomagnification ,Ecosystem services and carrying capacity ,Field visit

UNIT – II: Natural Resources

Types of resources (living & non-living) ,Water resources: use, overuse, floods, droughts ,Dams: advantages and problems ,Mineral resources and their impacts ,Land and forest resources ,Energy resources: renewable & non-renewable ,Alternate energy sources,Case studies

UNIT – III: Biodiversity

Meaning and types (genetic, species, ecosystem),Importance and values of biodiversity ,India as a biodiversity-rich nation, hotspots ,Threats: habitat loss, poaching, conflicts ,Conservation: in-situ and ex-situ methods ,Biodiversity Act ,Field visit

UNIT – IV: Environmental Pollution

Types of pollution ,Air, water, soil, and noise pollution (sources & effects) ,Solid waste and e-waste management ,Pollution control methods ,Wastewater treatment (basic idea) ,Climate change, ozone depletion, deforestation ,International agreements (Kyoto, Montreal, etc.)

UNIT – V: Environmental Laws & EIA

Environmental protection laws (Air, Water, Forest, Wildlife) ,Waste management rules ,Basics of Environmental Impact Assessment (EIA) ,Risk assessment and management plans ,Sustainable development and SDGs ,Current environmental issues

TEXT BOOKS:

1. Introduction to Environmental Science by Y. Anjaneyulu, BS. Publications.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.

SPHOORTHY ENGINEERING COLLEGE
(UGC AUTONOMOUS)

S25MA401BS: NUMERICAL METHODS AND COMPLEX VARIABLES

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Pre-requisites: Mathematics courses of first year of study.

Course Objectives: To learn

1. Expressing periodic function by Fourier series and a non-periodic function by Fourier transforms
2. Various numerical methods to find roots of polynomial and transcendental equations.
3. Concept of finite differences and to estimate the value for the given data using interpolation.
4. Evaluation of integrals using numerical techniques
5. Solving ordinary differential equations of first order using numerical techniques.
6. Differentiation and integration of complex valued functions.
7. Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
8. Expansion of complex functions using Taylor's and Laurent's series.

Course outcomes: After learning the contents of this paper, the student must be able to

1. Represent periodic and non-periodic functions using Fourier series and transforms.
2. Solve polynomial and transcendental equations using numerical methods.
3. Apply interpolation techniques to estimate values from given data.
4. Solve integrals and first-order differential equations using numerical methods.

5. Analyze complex functions using differentiation, integration, and Cauchy's theorems.
6. Expand complex functions using Taylor's and Laurent's series.

Course Articulation Matrix:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	2	1	-
CO2	3	3	1	1	-	-	-	-	-	-	-	2	1	-
CO3	3	2	1	1	-	-	-	-	-	-	-	2	1	-
CO4	3	3	2	1	-	-	-	-	-	-	-	2	2	1
CO5	3	3	1	2	-	-	-	-	-	-	-	2	1	-
CO6	3	2	1	1	-	-	-	-	-	-	-	2	1	-

UNIT-I: Fourier Series & Fourier Transforms

Fourier series – Dirichlet's Conditions – Half-range Fourier series – Fourier Transforms: Fourier Integral Theorem (Only statements), Fourier Sine and Cosine transforms (Elementary illustrations)

UNIT-II: Numerical Methods-I

Solution of polynomial and transcendental equations: Bisection method – Iteration Method – Newton- Raphson method and Regula-Falsi method. Finite differences: forward differences – backward differences – central differences – symbolic relations – Interpolation using Newton's forward and backward difference formulae – Lagrange's method of interpolation.

UNIT-III: Numerical Methods-II

Numerical integration: Trapezoidal rule - Simpson's 1/3rd and 3/8th rules.

Ordinary differential equations: Taylor's series – Euler's method – Runge-Kutta method of fourth order for first order ODE.

UNIT-IV: Complex Differentiation

Differentiation of Complex functions – Analyticity – Cauchy-Riemann equations (without proof) – Harmonic Functions – Finding harmonic conjugate – Milne-Thomson method – Elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

UNIT-V: Complex Integration

Line integral – Cauchy's theorem – Cauchy's Integral formula – Zeros of analytic functions – Singularities – Taylor's series – Laurent's series. Residues – Cauchy Residue theorem (All theorems without Proof).

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.

REFERENCE BOOKS

1. Murray R. Spiegel, Ph.D., Seymour Lipschutz, Ph.D., John J. Schiller, Ph.D., Dennis Spellman, Ph.D., Complex Variables (Schaum's outline).
2. M. K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical methods for Scientific and Engineering Computations, New Age International publishers.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley &Sons, 2006.
4. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Edition, Mc-Graw Hill, 2004.

SPHOORTHY
ENGINEERING COLLEGE
(UGC AUTONOMOUS)

S25EC402PC: ELECTROMAGNETIC FIELDS AND TRANSMISSION LINES

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives

1. To understand the fundamental laws and concepts of electrostatic and magnetostatic fields.
2. To distinguish between static and time-varying electromagnetic fields.
3. To apply Maxwell's equations and boundary conditions to solve engineering problems.
4. To analyze electromagnetic wave propagation in different media.
5. To study transmission lines and solve related problems using analytical methods and Smith charts.

Course Outcomes

1. Explain the basic laws and solve problems related to electrostatic and magnetostatic fields.
2. Differentiate between static and time-varying fields and apply Maxwell's equations and boundary conditions.
3. Analyze electromagnetic wave propagation in conductors and dielectric media
4. Evaluate transmission line parameters and solve related problems.
5. Use Smith chart techniques to analyze transmission line behavior.

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	3	1	-
CO2	3	3	1	1	-	-	-	-	-	-	-	3	1	-
CO3	3	3	2	2	-	-	-	-	-	-	-	3	2	1
CO4	3	3	2	1	1	-	-	-	-	-	1	3	2	1

CO5	3	2	2	1	1	-	-	-	-	-	1	3	2	1

UNIT I – Electrostatics

Review of Coordinate Systems & Vector Calculus, Coulomb's Law, Electric Field Intensity — Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and its applications, Electric Potential, Relation between E and V, Maxwell's Equations for Electrostatic Fields, Energy Density, Convection and Conduction Currents, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations, Capacitors–Parallel Plate, Coaxial, Spherical.

UNIT II - Magnetostatics

Biot-Savart's Law, Ampere's Circuit Law and its applications, Magnetic Flux Density, Maxwell's equations for Magnetostatic Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law.

UNIT III - Maxwell's Equations (Time Varying Fields)

Faraday's Law, Transformer and Motional EMF, Inconsistency in Ampere's Law and Displacement Current Density, Maxwell's Equations in Differential, Integral and Phasor form. Electric and magnetic Boundary Conditions (Dielectric – Dielectric, Conductor– Dielectric, Conductor– Free Space interfaces).

UNIT IV - EM Wave Characteristics

Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves–Definitions, Relation between E&H, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics — Characterization, Wave Propagation in Good Conductors and Good Dielectrics, Skin Depth, Surface Impedance, Wave Polarization. Poynting Vector and Poynting Theorem.

Reflection and Refraction of Plane Waves — Normal and Oblique Incidences for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection

UNIT V Transmission Lines

Types, Parameters, Equivalent Circuit, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts, Lossless Lines, Types of Distortions, condition for Distortion less transmission lines, Minimum Attenuation, Loading – Types of Loading, Input Impedance, SC and OC Lines, Reflection Coefficient, VSWR, Impedance Transformations - $\lambda/4$, $\lambda/2$, $\lambda/8$ Lines, Smith Chart- Configuration and Applications, Single Stub Matching.

TEXT BOOKS:

1. Engineering Electromagnetics–William H. Hayt Jr.and John A. Buck, 8thEd., McGrawHill,2014
2. Principles of Electromagnetics –Matthew N.O. Sadiku and S.V. Kulkarni, 6thEd., Oxford University Press, Asian Edition, 2015.

REFERENCES:

1. Electromagnetic Waves and Radiating Systems–E.C. Jordan and K.G. Balmain,2ndEd., PHI,2000.
2. Engineering Electromagnetics – NathanIda, 2ndEd., Springer (India) Pvt. Ltd., New Delhi,2005.
3. Electromagnetic Field Theory Fundamentals –Bhag Singh Guru and Husey in R. Hiziroglu, Cambridge University Press, 2nd Ed., 2006.

SPHOORTHY
ENGINEERING COLLEGE
(UGC AUTONOMOUS)

S25EC403PC: ANALOG AND DIGITAL COMMUNICATIONS

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Prerequisites: Signals and Systems

Course Objectives

1. To understand the basic concepts and requirements of analog and digital communication systems.
2. To study generation and detection of various analog modulation techniques.
3. To learn digital modulation techniques and baseband transmission methods.
4. To analyze the performance of communication systems in the presence of noise.
5. To understand transmitter and receiver structures and coding techniques.

Course Outcomes

1. Explain the fundamentals of analog and digital communication systems.
2. Analyze and design analog modulation and demodulation techniques.
3. Analyze digital modulation and baseband transmission techniques.
4. Evaluate the effect of noise on communication systems.
5. Explain the working of transmitters, receivers, and coding techniques.

Course Articulation Matrix:

COs \ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	3	2	1	-	-	-	-	-	-	-	-	3	1	-
CO2	3	3	2	1	-	-	-	-	-	-	-	3	2	1
CO3	3	3	2	1	1	-	-	-	-	-	-	3	2	1
CO4	3	3	1	2	-	-	-	-	-	-	-	3	1	-
CO5	3	2	2	1	-	-	-	-	-	-	1	3	2	1

UNIT - I

Amplitude Modulation

Need for modulation, Amplitude Modulation: Time and frequency domain description, Generation — Switching modulator, Detection - Envelope detector, DSB-SC Modulation: Generation — Balanced Modulator, Detection- Synchronous detector, COSTAS Loop, SSB Modulation: Time and frequency domain description, Generation — Phase discrimination Method and Demodulation - coherent detection, Vestigial side band modulation and demodulation.

Angle Modulation

Basic concepts of Phase Modulation, Frequency Modulation: Single tone frequency modulation, Spectrum Analysis, Carson's Rule, Generation of FM Waves- Armstrong Method, Detection of FM Waves - Phase locked loop, Comparison of FM and AM.

UNIT - II

Transmitters & Receivers

Classification of Transmitters, AM Transmitters, FM Transmitters**,** AM Receiver - Super heterodyne receiver, FM Receivers, Stereo FM multiplex reception, Comparison of AM and FM Receiver. Noise analysis in AM, DSB, SSB and FM Modulation System, Threshold effect in Angle Modulation

System, Pre- emphasis, and de-emphasis

Pulse Modulation

Types of Pulse modulation-PAM, PWM and PPM, Comparison of FDM and TDM.

UNIT - III

Detection and Estimation: Model of Digital Communication Systems, Geometric Interpretation of Signals, Gram-Schmidt Orthogonalization, Response of Bank of correlators to Noisy Input, Detection of Known Signals in Noise, Probability of error, Optimum Receivers Using Coherent Detection: Matched filter Receiver and its Properties, Correlation receiver, Detection of signals with unknown Phase in Noise

Base Band Shaping for Data Transmission: Requirements of a line encoding format, various line

encoding formats- Unipolar, Polar, Bipolar, Discrete PAM signals, Inter symbol interference, Nyquist's criterion, Correlation coding: Duobinary signaling, Modified Duobinary technique, generalized form of correlation coding, Eye pattern.

UNIT - IV

Digital Modulation Techniques:

PCM Generation and Reconstruction, Quantization Noise, Non-Uniform Quantization and Companding, DPCM, DM and Adaptive DM, Noise in PCM and DM.

Digital Modulation formats, Coherent binary modulation techniques (BPSK, BFSK), Coherent quadrature modulation techniques (QPSK), Non-Coherent binary modulation techniques (BFSK, DPSK), QAM, M-ary modulation techniques (PSK, FSK, QAM), Comparison of M-ary digital modulation techniques, power spectra, bandwidth efficiency, constellation diagrams.

UNIT - V

Information theory: Entropy, Information rate, Mutual information, Channel capacity of discrete channel, Shannon-Hartley law; Trade-off between bandwidth and SNR.
Source coding - Huffman coding, Shannon Fano coding, Channel coding - Linear block codes and cyclic codes.

TEXT BOOKS:

1. Electronics Communication Systems-Fundamentals through Advanced-Wayne Tomasi, 5th Edition, PHI, 2009.
2. Digital and Analog Communication System – K. Sam Shanmugam, Wiley, 2019.

REFERENCES:

1. Electronic Communications – Dennis Roddy and John Coolean, 4th Edition, PEA, 2004
2. Electronics & Communication System – George Kennedy and Bernard Davis, TMH, 2004
3. Communication System - Simon Haykin and Michael Moher, Wiley, 5th edition, 2022
4. Principles of Communication Systems - Herbert Taub, Donald L Schiling, Goutam Saha, 3rd Edition, McGraw-Hill, 2008.

SPHOORTHY ENGINEERING COLLEGE
(UGC AUTONOMOUS)

S25EC404PC: ELECTRONIC CIRCUIT ANALYSIS

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Course Objectives

1. To understand the design and analysis of multistage amplifiers and their frequency response.
2. To study transistor behavior at high frequencies using appropriate models.
3. To analyze feedback in amplifiers and its effect on system performance.
4. To design and analyze oscillator circuits for waveform generation.
5. To understand and design power amplifiers and multivibrator circuits.

Course Outcomes

1. Analyze multistage amplifiers and evaluate the effect of coupling methods on performance.
2. Apply high-frequency transistor models to analyze amplifier behavior and bandwidth.
3. Evaluate feedback amplifiers and their impact on gain, stability, and bandwidth.
4. Design and analyze oscillator circuits for sinusoidal signal generation.
5. Design power amplifiers and multivibrator circuits and assess their performance.

Course Articulation Matrix:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	-	-	3	2	1
CO2	3	3	2	2	1	-	-	-	-	-	-	3	2	1
CO3	3	3	2	2	-	-	-	-	-	-	1	3	2	1
CO4	3	3	3	2	-	-	-	-	-	-	1	3	2	2

CO5	3	3	3	2	1	-	-	-	-	-	1	3	3	2

UNIT - I:

Multistage Amplifiers: Classification of Amplifiers, Distortion in Amplifiers, Coupling schemes: RC, Transformer, Direct coupling, Frequency response of multistage amplifiers, Transistor configuration choice in cascade amplifiers, Cascade and Cascode amplifiers, Darlington pair amplifier.

High-Frequency Transistor Model: Hybrid-π model, Hybrid-π parameters: Conductances and capacitances, CE short-circuit current gain, Gain with resistive load and gain-bandwidth product

UNIT - II:

Feedback Amplifiers: Concept and need for feedback in amplifiers, Types and classification of feedback amplifiers, Characteristics of negative feedback: Gain stability, bandwidth, noise, distortion, Voltage series, Voltage shunt, Current series, Current shunt configurations.

UNIT - III:

Oscillators: Principle of positive feedback, Barkhausen Criterion for oscillations, LC Oscillators: Generalized analysis, Hartley, Colpitts, RC Oscillators: RC phase shift, Wien bridge, Crystal oscillator: Working and advantages

UNIT - IV:

Power Amplifiers: Classification: Class A, B, AB, C, Series-fed Class A amplifier, Transformer- coupled Class A amplifier, Class B amplifier: Push-pull, Complementary symmetry, Efficiency calculations and Crossover distortion.

UNIT - V:

Multivibrators: Analysis and design of Bistable, Monostable and Astable multivibrators and Schmitt Trigger using transistors.

Time Base Generators: General features of a time base signal, methods of generating time base waveform, Miller and Bootstrap time base generators, Linearity improvement techniques

TEXT BOOKS:

1. Millman, Jacob, and Christos C. Halkias. *Electronic Devices and Circuits*. McGraw-Hill Education, 2008.
2. Bell, David A. *Electronic Devices and Circuits*. Oxford University Press, 2008.
3. Sedra, Adel S., and Kenneth C. Smith. *Microelectronic Circuits*. 7th ed., Oxford University Press, 2015.

REFERENCE BOOKS:

1. Boylestad, Robert L., and Louis Nashelsky. *Electronic Devices and Circuit Theory*. 11th ed., Pearson Education, 2013.
2. Millman, Jacob, and Arvin Grabel. *Microelectronics*. 2nd ed., McGraw-Hill, 1987.
3. Malvino, Albert Paul. *Electronic Principles*. 7th ed., McGraw-Hill Education, 2007.
4. Millman, Jacob, and Herbert Taub. *Pulse, Digital, and Switching Waveforms*. McGraw-Hill Education, 1991.

SPHOORTHY ENGINEERING COLLEGE
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S25EC405PC: LINEAR AND DIGITAL IC APPLICATIONS

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Pre-requisite: Switching Theory and Logic Design.

Course Objectives

1. To understand the basic building blocks and characteristics of linear integrated circuits.
2. To study the operation and applications of operational amplifiers.
3. To learn waveform generation circuits and special function ICs such as timers and PLLs.
4. To analyze analog multipliers and data converter circuits.
5. To understand the fundamentals of digital integrated circuits and their characteristics.

Course Outcomes

1. Explain the fundamentals and building blocks of linear integrated circuits and operational amplifiers.
2. Analyze and design circuits using operational amplifiers for various applications.
3. Apply ICs like 555 timer and PLL for waveform generation and frequency control.
4. Design and analyze analog multipliers and data converter circuits.
5. Describe different digital IC families and evaluate their characteristics.

Course Articulation Matrix:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	3	1	-
CO2	3	3	2	1	-	-	-	-	-	-	-	3	2	1
CO3	3	3	2	1	-	-	-	-	-	-	1	3	2	1
CO4	3	3	3	2	1	-	-	-	-	-	1	3	3	2
CO5	3	2	1	1	-	-	-	-	-	-	-	3	1	-

UNIT - I

Operational Amplifier

Ideal and Practical Op-Amp Characteristics, Features of 741 Op- Amp, Modes of Operation - Inverting, Non-Inverting, Differential, Instrumentation Amplifier, AC Amplifier, Differentiators and Integrators, Comparators, Schmitt Trigger, Introduction to Voltage Regulators, Features of 723 Regulator, Three Terminal Voltage Regulators.

UNIT - II

Op-Amp, IC-555 & IC565 Applications

Introduction to Active Filters, Characteristics of Band pass, Band reject and All Pass Filters, Analysis of 1st order LPF & HPF Butterworth Filters, Waveform Generators — Triangular, Sawtooth, Square Wave, IC555 Timer - Functional Diagram, Monostable and Astable Operations, Applications, IC565 PLL - Block Schematic, principle and Applications.

UNIT - III

Data Converters

Introduction, Basic DAC techniques, Different types of DACs-Weighted resistor DAC, R-2Rladder DAC, Inverted R-2R DAC, Different Types of ADCs - Parallel Comparator Type ADC, Counter Type ADC, Successive Approximation ADC and Dual Slope ADC, DAC and ADC Specifications.

UNIT - IV

Combinational Logic ICs

Specifications and Applications of TTL-74XX & CMOS 40XX Series ICs - Code Converters, Decoders, LED & LCD Decoders with Drivers, Encoders, Priority Encoders, Multiplexers, Demultiplexers, Priority

Generators/Checkers, Parallel Binary Adder/Subtractor, Magnitude Comparators.

UNIT - V

Sequential Logic IC's and Memories

Familiarity with commonly available 74XX & CMOS40XX Series ICs– All Types of Flip-flops, Synchronous Counters, Decade Counters, Shift Registers. Memories - ROM Architecture, Types of ROMS & Applications, RAM Architecture, Static & Dynamic RAMs.

TEXT BOOKS

1. Op-Amps & Linear ICs– Ramakanth A. Gayakwad, PHI, 2003.
2. Digital Fundamentals –Floydand Jain, Pearson Education,8th Ed., 2005.

REFERENCE BOOKS

1. Linear Integrated Circuits –D. Roy Chowdhury, New Age International (p) Ltd, 2ndEd., 2003.
2. Digital Design Principles and Practices–John. F. Wakerly, Pearson 3rd Ed., 2009.
3. Linear Integrated Circuits and Applications – Salivahana, TMH, 2008.
4. OperationalAmplifierswithLinearIntegratedCircuits,4th Ed., William D. Stanley, Pearson Education India, 2009.

SPHOORTHY
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S25MA406PC: COMPUTATIONAL MATHEMATICS LAB

(Using Python/MATLAB software)

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Pre-requisites: Matrices, Iterative methods and ordinary differential equations

Course Objectives: To learn

1. Solve problems of Eigen values and Eigen Vectors using Python/MATLAB.
2. Solution of Algebraic and Transcendental Equations using Python/MATLAB
3. Solve problems of Linear system of equations
4. Solve problems of First-Order ODEs Higher order linear differential equations with constant coefficients

Course outcomes: After learning the contents of this paper, the student must be able to

1. Develop the code to find the Eigen values and Eigen Vectors using Python/MATLAB.
2. Develop the code find solution of Algebraic and Transcendental Equations and Linear system of equations using Python/MATLAB
3. Write the code to solve problems of First-Order ODEs Higher order linear differential equations with constant coefficients

Course Articulation Matrix:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO 1	3	2	1	1	3	-	-	-	-	-	-	2	3	1
CO 2	3	3	2	1	3	-	-	-	-	-	-	2	3	1
CO 3	3	3	2	2	3	-	-	-	-	-	-	2	3	1

*** Visualize all solutions Graphically through programmes**

UNIT - I: Eigen values and Eigenvectors: 6P

Programs:

- Finding real and complex Eigen values.
- Finding Eigen vectors.

UNIT-II: Solution of Algebraic and Transcendental Equations 6P

Bisection method, Newton Raphson Method

Programs:

- Root of a given equation using Bisection method.
- Root of a given equation Newton Raphson Method.

UNIT-III: Linear system of equations: 6P

Jacobi's iteration method and Gauss-Seidal iteration method

Programs:

- Solution of given system of linear equations using Jacobi's method
- Solution of given system of linear equations using Gauss-Seidal method

UNIT-IV: First-Order

ODEs

8P

Exact and non-exact equations, Applications: exponential growth/decay, Newton's law of cooling.

Programs:

- Solving exact and non-exact equations
- Solving exponential growth/decay and Newton's law of cooling problems

UNIT-V: Higher order linear differential equations with constant coefficients **6P**

- Solving homogeneous ODEs
- Solving non-homogeneous ODEs

TEXT BOOKS:

1. MATLAB and its Applications in Engineering, Rajkumar Basal, Ashok Kumar Geo, Manoj Kumar Sharma, Pearson publication.
2. Kenneth A. Lambert, The fundamentals of Python: First Programs, 2011, Cengage Learnings.
3. Think Python First Edition, by Allen B. Downey, Orielly publishing.
4. Introduction to Python Programming, William Mitchell, Povel Solin, Martin Novak et al., NCLab Public Computing, 2012.
5. Introduction to Python Programming, ©Jacob Fredslund, 2007.

REFERENCE BOOKS:

1. An Introduction to Python, John C. Lusth, The University of Alabama, 2011.
2. Introduction to Python, ©Dave Kuhlman, 2008.

SPHOORTHY ENGINEERING COLLEGE
(UGC AUTONOMOUS)

S25EC407PC: ANALOG AND DIGITAL COMMUNICATIONS LAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Course Objectives

1. To understand and implement analog modulation and demodulation techniques.
2. To study pulse modulation and sampling concepts through practical implementation.
3. To analyze digital modulation techniques and their performance.
4. To observe time and frequency domain characteristics of communication signals.
5. To develop skills in simulation and hardware implementation of communication systems.

Course Outcomes

1. Design and analyze analog modulation and demodulation techniques.
2. Design and implement pulse modulation techniques and analyze their performance
3. Demonstrate sampling concepts and analyze aliasing effects.
4. Design and analyze digital modulation and demodulation techniques.
5. Evaluate communication system performance using practical and simulation tools.

Course Articulation Matrix:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	-	3	1	2	2	-	2	3	2	-	3	2	1
CO2	1	-	3	1	2	2	-	2	3	2	-	3	2	1
CO3	1	-	3	1	2	2	-	2	3	2	-	3	2	1
CO4	1	-	3	1	2	2	-	2	3	2	-	3	2	2
CO5	1	-	3	2	2	2	-	2	3	2	1	3	3	2

Note

- Minimum 12 experiments must be performed.
- All experiments should be simulated Using MATLAB first and then implemented in hardware.

A. Analog Modulation Experiments

1. **Amplitude Modulation (AM)**
   How does modulation index affect AM signals? Generate and demodulate AM signals for different modulation indices and analyze waveforms and spectrum.
2. **Frequency Modulation (FM)**
   How do frequency and amplitude affect FM signals? Generate and demodulate FM signals and study variation in modulation index.
3. **DSB-SC Modulation**
   How is carrier suppressed in DSB-SC? Generate and demodulate DSB-SC signals and compare theoretical and practical results.
4. **SSB-SC Modulation**
   How is bandwidth reduced using SSB? Generate and demodulate SSB signals using phase shift method and analyze spectrum.
5. **Frequency Division Multiplexing (FDM)**
   How are multiple signals transmitted simultaneously? Implement FDM and recover signals without distortion.

B. Sampling & Pulse Modulation

1. **Sampling Theorem**
   What happens when sampling rate changes? Verify sampling theorem and observe aliasing effects.
2. **Pulse Amplitude Modulation (PAM)**
   How is signal amplitude represented in pulses? Design PAM modulator/demodulator using 555 timer.

3. **Pulse Width Modulation (PWM)**
   How does pulse width represent signal information? Implement PWM and observe waveform variations.
4. **Pulse Position Modulation (PPM)**
   How is signal information encoded in pulse position? Design and analyze PPM circuits.
5. **Pulse Code Modulation (PCM)**
   How is analog signal converted into digital form? Generate and demodulate PCM signals.
6. **Delta Modulation (DM)**
   How does DM simplify PCM? Generate and demodulate delta modulated signals.

C. Digital Modulation Experiments

1. **Frequency Shift Keying (FSK)**
   How are binary signals transmitted using frequency changes? Generate and demodulate FSK signals.
2. **Binary Phase Shift Keying (BPSK)**
   How does phase represent binary data? Implement BPSK modulation and demodulation.
3. **Differential PSK (DPSK)**
   How is phase difference used for transmission? Generate and analyze DPSK signals.
4. **Quadrature PSK (QPSK)**
   How can multiple bits be transmitted simultaneously? Implement QPSK and observe signal behavior.
5. **Constellation Diagrams**
   How are digital signals represented visually? Plot constellation diagrams for BPSK, BFSK, and QPSK.
6. **Performance in Noise**
   How does noise affect digital communication? Analyze performance using constellation diagrams.

D. Advanced Communication Concepts

1. **Inter-Symbol Interference (ISI)**
   How does ISI affect signal quality? Demonstrate ISI using eye diagrams.
2. **Pulse Shaping**
   How can ISI be reduced? Simulate raised cosine and duobinary signals.
3. **Source Coding**
   How is data efficiently encoded? Implement Shannon-Fano/Huffman coding.
4. **Matched Filter**
   How is signal detection improved in noise? Analyze performance of a matched filter.

SPHOORTHY
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S25EC408PC: ELECTRONIC CIRCUIT ANALYSIS LAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Course Objectives

1. To design and analyze multistage and power amplifiers using practical and simulation methods.
2. To study feedback and oscillator circuits and understand conditions for sustained oscillations.
3. To develop waveform generation circuits such as multivibrators and time base generators.
4. To use simulation tools for analyzing analog circuit performance.
5. To compare theoretical and practical results of analog circuits and understand real-world effects.

Course Outcomes

1. Design and analyze multistage and power amplifiers and evaluate their performance.
2. Implement and analyze feedback and oscillator circuits and verify oscillation conditions.
3. Design and analyze waveform generation circuits such as multivibrators.
4. Simulate analog circuits and evaluate their performance using software tools.
5. Compare practical results with theoretical values and identify deviations.

Course Articulation Matrix:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	-	-	-	-	-	3	2	1
CO2	3	3	3	2	2	1	-	-	-	-	-	3	2	1
CO3	3	3	3	2	1	-	-	-	-	-	-	3	2	1
CO4	2	2	3	3	3	-	-	-	-	-	1	2	3	2
CO5	3	3	2	3	2	1	-	-	-	-	1	3	3	2

Note

- Minimum **12 experiments** should be performed.
- All experiments must be **simulated first and then implemented in hardware**.

A. Software Simulation Experiments

1. **Feedback Amplifiers**
   How does feedback affect amplifier performance? Simulate different feedback amplifier topologies and compare gain and frequency response.
2. **Monostable Multivibrator**
   How is a single pulse generated? Simulate a monostable circuit and analyze input/output waveforms.
3. **Schmitt Trigger**
   How is noise immunity improved? Simulate Schmitt trigger and study hysteresis behavior.
4. **Time Base Generator (Bootstrap)**
   How are sweep signals generated? Simulate bootstrap circuit and observe output waveform.
5. **Miller Sweep Circuit**
   How does Miller effect help in waveform generation? Simulate Miller sweep circuit and analyze waveform.
6. **Push-Pull Power Amplifier**
   How is distortion reduced? Simulate complementary symmetry amplifier and verify crossover distortion elimination.

7. **Tuned Amplifier**
   How does resonance affect amplification? Simulate a single tuned amplifier and determine Q-factor.

B. Hardware Experiments

1. **Multistage Amplifier**
   How is gain improved using multiple stages? Design and analyze a two-stage RC coupled amplifier.
2. **Hartley & Colpitts Oscillators**
   How are sinusoidal oscillations generated? Design oscillators and observe output waveforms.
3. **RC Phase Shift Oscillator**
   What is the condition for oscillation? Design and verify gain condition for oscillations.
4. **Class A Power Amplifier**
   How is power amplification achieved? Design transformer-coupled amplifier and calculate efficiency.
5. **Class B Power Amplifier**
   How is efficiency improved? Design and analyze Class B amplifier and observe distortion.
6. **Bistable Multivibrator**
   How is binary switching achieved? Design bistable circuit and observe transistor waveforms.
7. **Astable Multivibrator**
   How are continuous pulses generated? Design and analyze astable multivibrator.
8. **Monostable Multivibrator**
   How is one-shot pulse generated? Design and observe waveform characteristics.

Software Requirements:

Simulation Tools: LTspice

Operating System: Windows 10/11 or Linux (Ubuntu preferred)

Hardware Requirements:

1. Dual Power Supply (±15V, 0–30V)
2. Function Generator (up to 1 MHz)
3. CRO / DSO (Dual Channel, 20 MHz or more)
4. Digital Multimeters
5. Breadboards and Connecting Wires
6. BJTs: BC107, BC547, BC557, 2N2222, etc.
7. Resistors, Capacitors (Wide range of values)
8. Transformers (for power amplifiers)
9. Inductors, Crystals (1 MHz, 4 MHz, etc.)
10. Heat sinks, transistors for power stages (e.g., TIP41, TIP42 etc.)

SPHOORTHY ENGINEERING COLLEGE
(UGC AUTONOMOUS)

S25EC409PC: LINEAR AND DIGITAL IC APPLICATIONS LAB
B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Course Objectives

1. To design and analyze analog circuits using operational amplifiers (IC 741).
2. To study waveform generation and multivibrator circuits using IC 555.
3. To design and implement digital circuits using standard logic ICs.
4. To understand data conversion techniques using ADC and DAC circuits.
5. To analyze voltage regulators and evaluate their performance.

Course Outcomes

1. Design and implement analog circuits using operational amplifiers.
2. Design and analyze multivibrator and waveform generation circuits using IC 555.
3. Design and implement digital circuits using logic ICs and verify their functionality.
4. Design and analyze ADC, DAC, and voltage regulator circuits.
5. Evaluate circuit performance and verify practical results with theoretical values.

Course Articulation Matrix:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	-	3	3	3	-	-	-	3	3	-	3	2	1
CO2	1	-	3	3	3	-	-	-	3	3	-	3	2	1
CO3	1	-	3	3	3	-	-	-	3	3	-	3	2	2
CO4	1	-	3	3	3	-	-	-	3	3	-	3	3	2
CO5	1	-	3	3	3	-	-	-	3	3	1	3	3	2

Note

- Minimum **12 experiments must be performed** out of 22.
- Verify IC functionality in each experiment.

List of Experiments

A. Analog Circuits using Op-Amp (IC 741)

1. **Amplifiers**

   How is signal amplification achieved? Design inverting and non-inverting amplifiers and calculate gain.
2. **Adder & Subtractor**

   How are analog signals mathematically combined? Design and verify addition and subtraction circuits.
3. **Comparator**

   How are signals compared? Design comparator and verify A=B, A>B, A<B conditions.
4. **Integrator & Differentiator**

   How are signals processed mathematically? Design and analyze integrator and differentiator circuits.
5. **Active Filters**

   How are frequencies controlled? Design LPF and HPF (2 kHz) and determine cutoff and roll-off.
6. **Waveform Generator**

   How are periodic signals generated? Design circuits to generate sine, square, and triangular waves.

B. Multivibrators & Signal Circuits (IC 555 & Others)

1. **Monostable Multivibrator**

   How is a single pulse generated? Construct using IC 555 and observe waveform.

2. **Astable Multivibrator**

   How are continuous pulses generated? Construct and calculate frequency and duty cycle.

3. **Schmitt Trigger**

   How is noise immunity achieved? Design circuit and determine UTP and LTP.

4. **Frequency Modulator & Demodulator**

   How is information transmitted using frequency? Design FM modulator/demodulator and observe waveforms.

C. Data Converters & Regulators

1. **Voltage Regulators**

   How is constant voltage maintained? Design regulators using IC723/78xx and evaluate load regulation.

2. **DAC (R-2R Ladder)**

   How is digital converted to analog? Design DAC and determine resolution.

3. **ADC Circuits**

   How is analog converted to digital? Design ADC (parallel/counter/SAR) and evaluate performance.

D. Digital Circuits (Combinational Logic)

1. **Gray Code Converter**

   How is data represented efficiently? Design and verify Gray code converter.

2. **Priority Encoder**

   How are multiple inputs encoded? Design encoder and verify truth table.

3. **Multiplexer (8×1)**

   How is data selected? Design multiplexer and verify operation.

4. **Adder/Subtractor (4-bit)**

   How are binary operations performed? Design 4-bit adder/subtractor and test given inputs.

5. **Encoder & Decoder**

   How is data encoded and decoded? Design 8×3 encoder and 3×8 decoder.

E. Sequential Circuits

1. **Decade Counter**

   How is counting sequence generated? Design and verify output waveforms.
2. **Up/Down Counter**

   How is bidirectional counting achieved? Design using IC74163 and observe operation.
3. **Universal Shift Register**

   How is data shifted and stored? Design using IC74194/195 and verify modes.
4. **RAM Design**

   How is data stored and accessed? Design 16×4 RAM and verify read/write operations.

SPHOORTHY ENGINEERING COLLEGE
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S25EC410SD: PCB Design and Prototyping

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Course Objectives

1. Understand basics of PCB design and workflow
2. Learn to use EDA tools for schematic and layout design
3. Gain knowledge of PCB fabrication process
4. Learn operation of Laser Cutting and CNC machines
5. Develop skills in digital fabrication and prototyping

Course Outcomes

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

1. Explain PCB design process and tools
2. Design simple PCB circuits using EDA software
3. Fabricate basic PCB layouts and generate files
4. Operate Laser Cutting and CNC machines safely
5. Build and test functional prototypes

Course Articulation Matrix:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	2	-	-	-	-	1	-	2	-
CO2	3	3	2	1	3	-	-	-	-	1	-	3	1
CO3	2	2	3	2	3	-	-	-	-	1	-	3	2
CO4	1	1	2	2	2	-	-	-	1	1	-	2	3
CO5	2	2	3	3	3	1	1	-	2	2	1	3	3

UNIT–I: PCB Design Basics

Introduction to PCB and types ,PCB design flow,EDA tools (KiCad/Eagle) ,Components and footprints,Basic schematic design ,Simple case studies

UNIT–II: PCB Layout & Fabrication

Schematic capture ,PCB layout and routing,Design rules (DRC) ,Gerber file generation ,Basics of PCB fabrication ,Safety practices

UNIT–III: Laser Cutting

Basics of laser cutting ,Types of lasers ,Materials (Acrylic, MDF, Plywood),Design files (DXF, SVG) ,Machine operation ,Applications in enclosures

UNIT–IV: CNC Router

Basics of CNC machines ,CNC router working ,G-code basics ,CAM software basics ,Tool paths and setup ,Applications in prototyping

UNIT–V: Integration & Mini Project

PCB and enclosure integration ,Assembly techniques ,Testing and debugging ,Rapid prototyping

Text Books

1. Simon Monk, *Make Your Own PCBs with EAGLE*, McGraw Hill
2. Brian Evans, *Beginning Arduino Programming* (for PCB applications)

Reference Books:

1. Chris Schroeder, *Printed Circuit Board Design Using AutoCAD*
2. Hans-Peter Baehr, *CNC Programming Handbook*

E-Resources:

- NPTEL: PCB Design & Manufacturing
- KiCad official tutorials
- CNC & Laser cutting tutorials (YouTube / Autodesk)
- SDG learning resources