3EC2-01	BSC	Advance Engineering Mathematics-I	MM:150	3L:0T:0P	3 credits

Numerical Methods – 1: (10 lectures)
Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Gauss's forward and backward interpolation formulae. Stirling's Formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae. Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.
Numerical Methods – 2: (8 lectures)
Numerical solution of ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Solution of polynomial and transcendental equations-Bisection method, Newton-Raphson method and Regula-Falsi method.
Laplace Transform: (10 lectures)
Definition and existence of Laplace transform, Properties of Laplace Transform and formulae, Unit Step function, Dirac Delta function, Heaviside function, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs by Laplace transforms method.
Fourier Transform: (7 lectures)
Fourier Complex, Sine and Cosine transform, properties and formulae, inverse Fourier transforms, Convolution theorem, application of Fourier transforms to partial ordinary differential equation (One dimensional heat and wave equations only).
Z-Transform: (5 lectures)
Definition, properties and formulae, Convolution theorem, inverse Z-transform, application of Z-transform to difference equation.

Suggested Text/Reference Books
1. Franscis Scheid, Theory and Problems of Numerical Analysis, Schaum Outline's series. 2. S. S. Sastry; Introductory Methods of Numerical Analysis; Prentice Hall India Learning Private Limited.

3. M. K. Jain, S. R. K. Iyengar and R. K. Jain; Numerical Methods for Scientific and Engineering Computation; New Age International Publishers.
4. Spiegel; Laplace Transforms; Schaum's outline series.
5. Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
6. R.K. Jain and S.R.K. Iyengar; Advanced Engineering Mathematics, Narosa Publications.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
8. Dennis G. Zill and Warren S. Wright; Advanced Engineering Mathematics; Jones & Bartlett Learning.
9. Pal and Bhunia, Engineering Mathematics, Oxford, India.
10. C.B. Gupta, Engineering Mathematics for semesters III and IV, Mc Graw Hill Education, India.
11. Chapra, Numerical Methods for Engineers, Mc Graw Hill Education, India.

3EC1-02/ 4EC1-02	HSMC	Technical Communication	MM:100	2L:0T:0P	2 credit

SN		Hours
1	**Vocabulary Building.** Concept of Word Formation. Affixes. Synonyms and Antonyms.	5
2	**Grammar** Words and Sentences. Verbs and Tenses. Questions and Question Tags. The Infinitive and the '…ing' form.	5
3	**Grammar** Nouns and Articles. Determiners. Adjectives and Adverbs. Relative clauses.	5
4	**Identifying Common Errors in Writing** Subject- Verb Agreement. Noun-Pronoun Agreement. Articles. Prepositions.	5
5	**Composition** Précis Writing. Essay Writing. Comprehension of Passage.	5

Suggested Text/Reference Books

1. "Technical Communication", 2018, Rajesh K. Lidiya, Oxford University Press, India.
2. Communication Skills, Pushplata & Sanjay Kumar, Oxford University Press, India.
3. The Written Word, Vandana Singh, Oxford University Press, India.
4. Current English Grammar and Usage with Composition, R. P. Sinha, Oxford University Press, India.
5. Rodriques M. V., 'Effective Business Communication', Concept Publishing Company, New Delhi, 1992 reprint (2000).
6. Bansal, R K and Harrison J B, 'Spoken English' Orient Longman, Hyderabad.
7. Binod Mishra & Sangeeta Sharma, 'Communication Skills for Engineers and Scientists, PHI Learning Private Ltd, New Delhi, 2011.
8. Gartside L. 'Modern Business Correspondence, Pitman Publishing, London.

3EC1-03/ 4EC1-03	HSMC	Managerial Economics And Financial Accounting	MM:100	2L:0T:0P	2 credit

Syllabus

1)Basic economic concepts-
Meaning, nature and scope of economics, deductive vs inductive methods, static and dynamics, Economic problems: scarcity and choice, circular flow of economic activity, national income-concepts and measurement.
2) Demand and Supply analysis-
Demand-types of demand, determinants of demand, demand function, elasticity of demand, demand forecasting –purpose, determinants and methods, Supply-determinants of supply, supply function, elasticity of supply.
3) Production and Cost analysis-
Theory of production- production function, law of variable proportions, laws of returns to scale, production optimization, least cost combination of inputs, isoquants. Cost concepts-explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation.
4) Market structure and pricing theory-
Perfect competition, Monopoly, Monopolistic competition, Oligopoly.
5) Financial statement analysis-
Balance sheet and related concepts, profit and loss statement and related concepts, financial ratio analysis, cash-flow analysis, funds-flow analysis, comparative financial statement, analysis and interpretation of financial statements, capital budgeting techniques.
Suggested Text//References Books:
1. Samuelson,Paul A and Nordhaus, William. D. Economics, Mc Graw Hill (2009)
2. Krugman,Paul and Wells Robin, Economics, W.H.Freeman and co. ltd. Fourth edition.(2015)
3. Salvatore,D. and Srivastav,R, Managerial economics: Principles and worldwide applications, Oxford University press, sixth edition, (2008).
4. Pindyck,R.S and Rubinfeld, D.I, Microeconomics, Mc millan(2007).
5. Prasanna Chandra, Fundamentals of financial management, Tata mc Graw Hill Publishing ltd., fourth edition, (2005).

3EC4-04	PCC	Digital System Design	MM:150	3L:0T:0P	3 credits

Syllabus

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.
MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU
Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of Synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation.
Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using programmable devices.
VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Text/Reference Books:

1.	R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2.	Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3.	W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition ,2006.
4.	D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989
5.	Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

Course Outcome:

Course Code	Course Name	Course Outcome	Details
3EC4-04	Digital System Design	CO 1	Develop the understanding of number system and its application in digital electronics.
		CO 2	Development and analysis of K-map to solve the Boolean function to the simplest form for the implementation of compact digital circuits.
		CO 3	Design various combinational and sequential circuits using various metrics: switching speed, throughput/latency, gate count and area, energy dissipation and power.
		CO 4	Understanding Interfacing between digital circuits and analog component using Analog to Digital Converter (ADC), Digital to Analog Converter (DAC) etc.
		CO 5	Design and implement semiconductor memories, programmable logic devices (PLDs) and field programmable gate arrays (FPGA) in digital electronics.

CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
3EC4-04 Digital System Design	CO 1	3	2	2	1		1						
	CO 2	3	2	3	2								
	CO 3	2	2	3	1	1							
	CO 4	3	2	1	1	1							
	CO 5	2	1	3	1	1							

3: Strongly **2: Moderate** **1: Weak**

Lecture Plan:

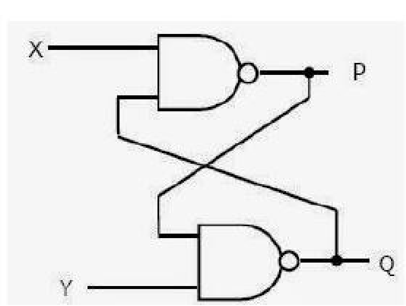
Lecture No.	Content to be taught
Lecture 1	Zero Lecture
Lecture 2	Review of Boolean Algebra
Lecture 3	DeMorgan's Theorem, SOP & POS forms,
Lecture 4	Problem of SOP and POS forms of boolean functions.
Lecture 5	Simplification of karnaugh map up to 6 variables
Lecture 6	Simplification of karnaugh map up to 6 variables
Lecture 7	Simplification of karnaugh map up to 6 variables
Lecture 8	Binary codes and code conversion
Lecture 9	Binary codes and code conversion
Lecture 10	Encoder, Decoder
Lecture 11	Half and Full Adders, Subtractors, Serial and Parallel Adders
Lecture 12	BCD Adder, Barrel shifter
Lecture 13	S-R FF, edge triggered and level triggered
Lecture 14	D and J-K FF
Lecture 15	Master-Slave JK FF and T FF
Lecture 16	Ripple and Synchronous counters
Lecture 17	Other type of counters
Lecture 18	Shift registers, Finite state machines, Asynchronous FSM
Lecture 19	Design of synchronous FSM
Lecture 20	Design of synchronous FSM
Lecture 21	Design of synchronous FSM
Lecture 22	Designing synchronous circuits (pulse train generator, pseudo random binary sequence generator, clock generation)
Lecture 23	TTL NAND gate, specifications, noise margin, propagation delay, fan-in, fan-out

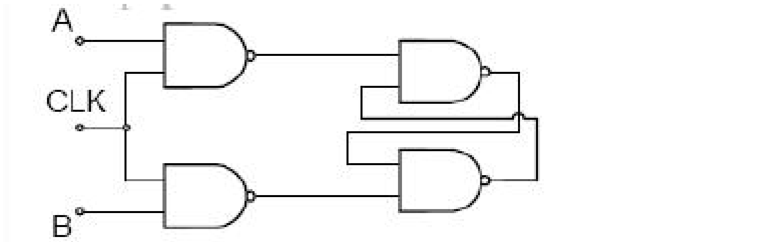
Lecture 24	TTL NAND gate
Lecture 25	Tristate TTL, ECL
Lecture 26	CMOS families and their interfacing
Lecture 27	CMOS families and their interfacing
Lecture 28	Read-Only Memory, Random Access Memory
Lecture 29	Programmable Logic Arrays (PLA)
Lecture 30	Programmable Array Logic (PAL),
Lecture 31	Field Programmable Gate Array (FPGA)
Lecture 32	Combinational PLD-Based State Machines,
Lecture 33	State Machines on a Chip
Lecture 34	Schematic, FSM & HDL
Lecture 35	Different modeling styles in VHDL
Lecture 36	Data types and objects, Data flow
Lecture 37	Behavioral and Structural Modeling
Lecture 38	Behavioral and Structural Modeling
Lecture 39	Simulation VHDL constructs and codes for combinational and sequential circuits
Lecture 40	Simulation VHDL constructs and codes for combinational and sequential circuits

Content delivery method:

1. Chalk and Duster
2. PPT
3. Hand-outs

Sample Assignments:

Assignment 1	**Q1.** Using K-maps, find the minimal Boolean expression of the following SOP and POS representations. a. f (w,x,y,z)= Σ (7,13,14,15) b. f(w,x,y,z) = Σ (1,3,4,6,9,11,14,15) c. f(w,x,y,z) = Π(1,4,5,6,11,12,13,14,15) d. f(w,x,y,z) = Σ (1,3,4,5,7,8,9,11,15) e. f(w,x,y,z) = Π (0,4,5,7,8,9,13,15)
	Q2. Find the function h(a,b,c,d) such that $f = f^d$. f (a,b,c,d) = a ·b· c + (a · c + b)· d + h(a,b,c,d)
	Q3. Using K-maps of the functions f1 and f2, find the following: (provide the canonical form expression and simplify) a. T1 = f1 · f2 b. T2 = f1 + f2 c. T3 = f1 ⊕ f2 where f1(w,x,y,z) = Σ (0,2,4,9,12,15), f2(w,x,y,z) = Σ (1,2,4,5,12,13)
Assignment 2	**Q1**. Draw the state diagram of a serial adder.
	Q2. In the following circuit, given binary values were applied to the Inputs X and Y inputs of the NAND latch shown in the figure. X = 0, Y = 1; X = 0, Y = 0; X = 1, Y = 1. Find out the corresponding stable output P, Q. 
	Q3. When the race around condition will occur in the circuit

	given Below: 

3EC4-05	PCC	Signals &Systems	MM:150	3L:0T:0P	3 credits

Syllabus

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 and difference equations
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
The Laplace Transform, notion ofeigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behavior.
The z-Transform for discrete time signals and systems- eigen functions, region of convergence, z-domain analysis.
State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role. The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.

Text/Reference Books:

1.	A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2.	R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
3.	Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
4.	B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.

5.	Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
6.	Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.
7	Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
8.	M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003.
9.	J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.
10.	Ashok Ambardar,"Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.

Course Outcome:

Course Code	Course Name	Course Outcome	Details
3EC4-05	**Signals & Systems**	**CO 1**	Analyze different types of signals and system properties
		CO 2	Represent continuous and discrete systems in time and frequency domain using different transforms
		CO 3	Investigate whether the system is stable.
		CO 4	Sampling and reconstruction of a signal.
		CO 5	Acquire an understanding of MIMO systems

CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
3EC4-05 Signals & Systems	**CO 1**	3	3	1	2	2			1				2
	CO 2	3	1		2	3			1				2
	CO 3	3	2	2	3								2
	CO 4	3	2	3	3	1							
	CO 5	3	2	2	3	1			2				1

3: Strongly **2: Moderate** **1: Weak**

Lecture Plan:

Lecture No.	Content to be taught
Lecture 1	Zero Lecture
Lecture 2	Energy signals power signals
Lecture 3	Continuous and discrete time signals
Lecture 4	Continuous amplitude signals
Lecture 5	and discrete amplitude signals
Lecture 6	System properties: linearity: additivity and homogeneity
Lecture 7	shift-invariance, causality
Lecture 8	stability, realizability.
Lecture 9	Linear shift-invariant (LSI) systems
Lecture 10	impulse response
Lecture 11	Step response
Lecture 12	Convolution.
Lecture 13	Input output behavior with aperiodic convergent inputs
Lecture 14	Characterization of causality and stability of linear shift-invariant systems.
Lecture 15	System representation through differential equations and difference equations.
Lecture 16	Characterization of causality and stability of linear shift-invariant systems.
Lecture 17	System representation through differential equations and difference equations.
Lecture 18	Periodic and semi-periodic inputs to an LSI system
Lecture 19	The notion of a frequency response.

Lecture 20	Its relation to the impulse response
Lecture 21	Fourier series representation
Lecture 22	Fourier Transform
Lecture 23	Convolution/multiplication and their effect in the frequency domain
Lecture 24	Magnitude and phase response
Lecture 25	Fourier domain duality.
Lecture 26	The Discrete-Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT).
Lecture 27	Parseval's Theorem. The idea of signal space and orthogonal bases
Lecture 28	The Laplace Transform
Lecture 29	Notion of eigen functions of LSI systems
Lecture 30	A basis of eigen functions, region of convergence
Lecture 31	Poles and zeros of system, Laplace domain analysis,
Lecture 32	Solution to differential equations and system behavior.
Lecture 33	The z-Transform for discrete time signals and systems- eigen functions,
Lecture 34	Region of convergence, z-domain analysis.
Lecture 35	State-space analysis and multi-input, multi-output representation.
Lecture 36	The state-transition matrix and its role.
Lecture 37	The Sampling Theorem and its implications- Spectra of sampled signals.
Lecture 38	Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on
Lecture 39	Aliasing and its effects.
Lecture 40	Relation between continuous and discrete time systems.

Content delivery method:

1. Chalk and Duster
2. PPT
3. Animation
4. Hand-outs

Assignments:

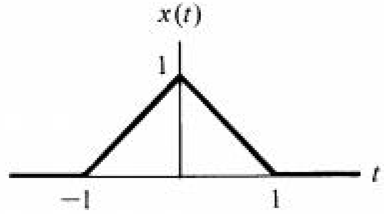
<table>
<tr>
<td>Assignment</td>
<td>
For each of the following signals, determine whether it is even, odd, or neither.
(a)


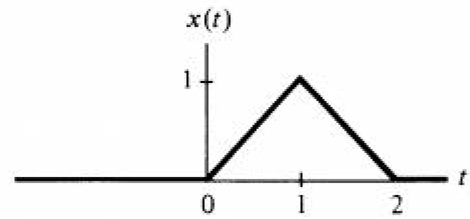
Figure P2.4-1
(b)


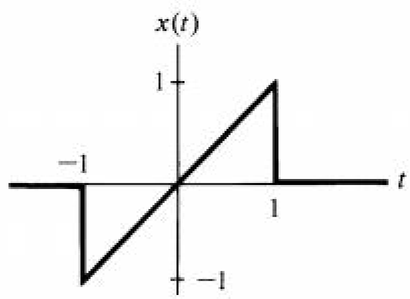
Figure P2.4-2
(c)


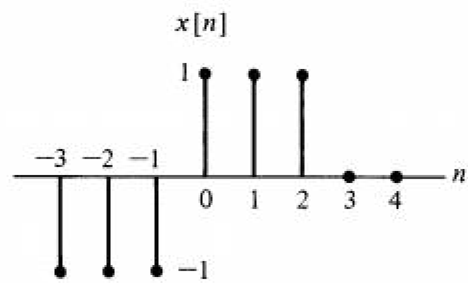
Figure P2.4-3
(d)


Figure P2.4-4
</td>
</tr>
</table>

	Evaluate the following sums: **(a)** $\sum_{n=0}^{5} 2\left(\frac{3}{a}\right)^{n}$ **(b)** $\sum_{n=2}^{6} b^{n}$ **(c)** $\sum_{n=0}^{\infty} \left(\frac{2}{3}\right)^{2n}$ *Hint:* Convert each sum to the form $$C\sum_{n=0}^{N-1} \alpha^n = S_N \quad \text{or} \quad C\sum_{n=0}^{\infty} \alpha^n = S_\infty$$ and use the formulas $$S_N = C\left(\frac{1-\alpha^N}{1-\alpha}\right), \quad S_\infty = \frac{C}{1-\alpha} \quad \text{for } \lvert\alpha\rvert < 1$$
	The first-order difference equation $y[n] - ay[n-1] = x[n]$, $0 < a < 1$, describes a particular discrete-time system initially at rest. **(a)** Verify that the impulse response $h[n]$ for this system is $h[n] = a^n u[n]$. **(b)** Is the system (i) memoryless? (ii) causal? (iii) stable? Clearly state your reasoning. **(c)** Is this system stable if $\lvert a\rvert > 1$?

Assignment	
	Consider a discrete-time system with impulse response $$h[n] = (\tfrac{1}{2})^n u[n]$$ Determine the response to each of the following inputs: **(a)** $x[n] = (-1)^n = e^{j\pi n}$ for all n **(b)** $x[n] = e^{j(\pi n/4)}$ for all n **(c)** $x[n] = \cos\left(\frac{\pi n}{4} + \frac{\pi}{8}\right)$ for all n
	Consider two specific periodic sequences $\tilde{x}[n]$ and $\tilde{y}[n]$. $\tilde{x}[n]$ has period N and $\tilde{y}[n]$ has period M. The sequence $\tilde{w}[n]$ is defined as $\tilde{w}[n] = \tilde{x}[n] + \tilde{y}[n]$. **(a)** Show that $\tilde{w}[n]$ is periodic with period MN. **(b)** Since $\tilde{x}[n]$ has period N, its discrete Fourier series coefficients a_k also have period N. Similarly, since $\tilde{y}[n]$ has period M, its discrete Fourier series coefficients b_k also have period M. The discrete Fourier series coefficients of $\tilde{w}[n]$, c_k, have period MN. Determine c_k in terms of a_k and b_k.
	The sequence $x[n] = (-1)^n$ is obtained by sampling the continuous-time sinusoidal signal $x(t) = \cos \omega_0 t$ at 1-ms intervals, i.e., $$\cos(\omega_0 nT) = (-1)^n, \qquad T = 10^{-3}\ \text{s}$$ Determine three *distinct* possible values of ω_0.

3EC4-06	PCC	Network Theory	MM:200	3L:1T:0P	4 credits

Syllabus

Node and Mesh Analysis, matrix approach of network containing voltage and current sources, and reactances, source transformation and duality.
Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC. circuits.
Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.
Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions..
Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem and Two four port network and interconnections, Behaviors of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.

Text/Reference Books:

1.	Van, Valkenburg.; "Network analysis" ; Prentice hall of India, 2000
2.	Sudhakar, A., Shyammohan, S. P.; "Circuits and Network"; Tata McGraw-Hill New Delhi, 1994
3.	A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education

Course Outcome:

Course Code	Course Name	Course Outcome	Details
3EC4-06	Network Theory	CO 1	Apply the basic circuital law and simplify the network using network theorems
		CO 2	Appreciate the frequency domain techniques in different applications.
		CO 3	Apply Laplace Transform for steady state and transient analysis
		CO 4	Evaluate transient response and two-port network parameters
		CO 5	Analyze the series resonant and parallel resonant circuit and design filters

CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
3EC4-06 Network Theory	CO 1	3	2		3	2							
	CO 2	3	3	1	2	2							1
	CO 3	3	2	2		2							1
	CO 4	2	3	2	2	1							
	CO 5	2	3	3	2	1							

3: Strongly **2: Moderate** **1: Weak**

Lecture Plan:

Lecture No.	Content to be taught
Lecture 1	Overview of Network Theory and its significance
Lecture 2	Node and Mesh Analysis
Lecture 3	matrix approach of network containing voltage and current sources and reactances
Lecture 4	source transformation and duality
Lecture 5	Network theorems: Superposition and reciprocity
Lecture 6	Thevenin’s and Norton’s theorem
Lecture 7	Maximum power Transfer theorem
Lecture 8	compensation and Tallegen's theorem as applied to AC. Circuits
Lecture 9	Trigonometric and exponential Fourier series
Lecture 10	Fourier series: Discrete spectra and symmetry of waveform
Lecture 11	Steady state response of a network to non-sinusoidal periodic inputs
Lecture 12	power factor and effective values
Lecture 13	Fourier transform and continuous spectra
Lecture 14	three phase unbalanced circuit and power calculation
Lecture 15	three phase unbalanced circuit and power calculation
Lecture 16	Laplace transforms
Lecture 17	Laplace transforms
Lecture 18	Laplace transforms properties: Partial fractions
Lecture 19	singularity functions and waveform synthesis
Lecture 20	analysis of RC networks

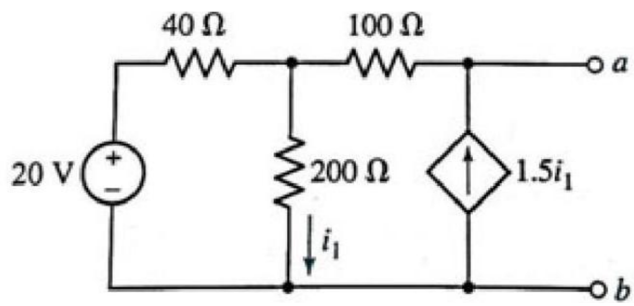
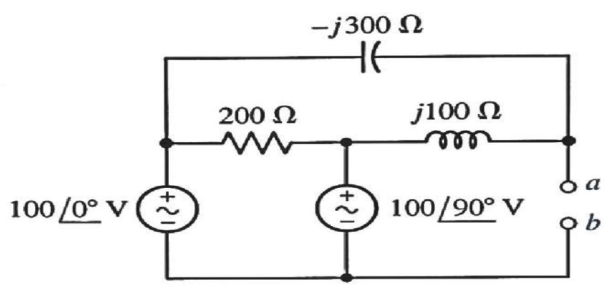
Lecture 21	analysis of RL networks
Lecture 22	analysis of RLC networks
Lecture 23	Analysis of networks with and without initial conditions
Lecture 24	Analysis of networks with and without initial conditions
Lecture 25	Analysis of networks with and without initial conditions with lapalace transforms evaluation
Lecture 26	Analysis of networks with and without initial conditions with lapalace transforms evaluation of initial condition
Lecture 27	Transient behavior
Lecture 28	concept of complex frequency
Lecture 29	Driving points and transfer functions poles and zeros of immittance function
Lecture 30	Driving points and transfer functions poles and zeros of immittance function: their properties
Lecture 31	sinusoidal response from pole-zero locations
Lecture 32	sinusoidal response from pole-zero locations
Lecture 33	convolution theorem
Lecture 34	sinusoidal response from pole-zero locations
Lecture 35	Two four port network and interconnections
Lecture 36	Two four port network and interconnections
Lecture 37	Behaviors of series and parallel resonant circuits
Lecture 38	Introduction to band pass and low pass
Lecture 39	Introduction to high pass and reject filters
Lecture 40	Spill over class

Content delivery method:

1. Chalk and Duster
2. PPT
3. Hand-outs

Sample assignments:

Assignment 1	**Q1.**	Elaborate the significance of source transformation with relevant example
	Q2.	State and prove time differentiation theorem in Laplace Transform

	Q3. Find the Thevenin equivalent of the network shown in figure. What power would be delivered to a load of 100 ohms at *a* and *b*? 
Assignment 2	**Q4.** Calculate Thevenin equivalent circuit with respect to terminals *a* and *b* 
	Q5. Derive transient current and voltage responses of sinusoidal driven RL and RC circuits.
	Q6. Specify the restrictions on pole and zero locations for transfer functions and driving-point functions.

3EC4-07	PCC	Electronic Devices	MM:200	3L:1T:0P	4 credits

Syllabus

Introduction to Semiconductor Physics: Introduction, Energy band gap structures of semiconductors, Classifications of semiconductors, Degenerate and non-degenerate semiconductors, Direct and indirect band gap semiconductors, Electronic properties of Silicon, Germanium, Compound Semiconductor, Gallium Arsenide, Gallium phosphide & Silicon carbide, Variation of semiconductor conductivity, resistance and bandgap with temperature and doping. Thermistors, Sensitors.
Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors.
Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-V characteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode.
Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model, MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, LED, photodiode and solar cell.
Integrated circuit fabrication process: oxidation, diffusion, ion implantation, Photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

Text/Reference Books:

1.	G. Streetman, and S. K. Banerjee, “Solid State Electronic Devices,” 7th edition, Pearson,2014.
2.	D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
3.	S. M. Sze and K. N. Kwok, “Physics of Semiconductor Devices,” 3rd edition, John Wiley & Sons, 2006.
4.	C.T. Sah, “Fundamentals of solid state electronics,” World Scientific Publishing Co. Inc, 1991.
5.	Y. Tsividis and M. Colin, “Operation and Modeling of the MOS Transistor,” Oxford Univ.Press, 2011.

Course Outcome:

Course Code	Course Name	Course Outcome	Details
3EC4-07	Electronic Devices	CO 1	Understanding the semiconductor physics of the intrinsic, P and N materials.
		CO 2	Understanding the characteristics of current flow in a bipolar junction transistor and MOSFET.
		CO 3	Understand and utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems.
		CO 4	Analyze the characteristics of different electronic devices such as Amplifiers, LEDs, Solar cells, etc.
		CO 5	Theoretical as well as experimental understanding of Integrated circuit fabrication.

CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
3EC4-07 Electronic Devices	CO 1	3	1		2	1	1						
	CO 2	3	2	1			2						
	CO 3	2	1		2		1	2					
	CO 4	3	1	1				2					
	CO 5	3	1	1	1	1							2

3: Strongly **2: Moderate** **1: Weak**

Lecture Plan:

Lecture No.	Content to be taught
Lecture 1	Zero Lecture
Lecture 2	Introduction to Semiconductor Physics
Lecture 3	Introduction to Semiconductor Physics
Lecture 4	Introduction to Semiconductor Physics

Lecture 5	Review of Quantum Mechanics
Lecture 6	Electrons in periodic Lattices
Lecture 7	E-k diagrams
Lecture 8	Energy bands in intrinsic and extrinsic silicon
Lecture 9	Carrier transport: diffusion current, drift current, mobility and resistivity
Lecture 10	Sheet resistance and design of resistors
Lecture 11	Generation and recombination of carriers
Lecture 12	Poisson and continuity equation
Lecture 13	P-N junction characteristics and their I-V characteristics
Lecture 14	P-N junction characteristics and their I-V characteristics
Lecture 15	P-N junction small signal switching models
Lecture 16	P-N junction small signal switching models
Lecture 17	Avalanche breakdown
Lecture 18	Zener diode and Schottky diode
Lecture 19	Basics of Bipolar Junction Transistor
Lecture 20	I-V characteristics of BJT
Lecture 21	Ebers-Moll Model
Lecture 22	MOS capacitor
Lecture 23	MOS capacitor
Lecture 24	C-V characteristics
Lecture 25	Basics of MOSFET
Lecture 26	Basics of MOSFET
Lecture 27	I-V characteristics of MOSFET
Lecture 28	Small signal models of MOS transistor
Lecture 29	Small signal models of MOS transistor
Lecture 30	Light Emitting Diode
Lecture 31	Photodiode and solar cell

Lecture 32	Basics of Integrated Circuits
Lecture 33	Advancement in Integrated Circuits
Lecture 34	Oxidation, diffusion and ion implantation
Lecture 35	Photolithography and etching
Lecture 36	Chemical vapor deposition
Lecture 37	Sputtering
Lecture 38	Twin-tub CMOS process
Lecture 39	Spill over class
Lecture 40	Spill over class

Content delivery method:

1. Chalk and Duster
2. PPT
3. Hand-outs

Sample assignments:

Assignment 1	**Q1.**	Investigates the input/output characteristics of various diodes?
	Q2.	Investigate the applications of various diodes?
	Q3.	A p-type sample of silicon has a resistivity of 5 Ω-cm. In this sample, the hole mobility, μ_h, is 600 cm^2/V-s and the electron mobility, μ_e, is 1600 cm^2/V-s. Ohmic contacts are formed on the ends of the sample and a uniform electric field is imposedwhich results in a drift current density in the sample is 2 x 10^3 A/cm^2. [1]. What are the hole and electron concentrations in this sample? [2]. What are the hole and electron drift velocities under these conditions? [3]. What is the magnitude of the electric field?
Assignment 2	**Q1.**	Discuss the applications of Ebers-Moll Model.
	Q2.	Discuss different types of fabrication techniques.
	Q3.	Discuss various characteristics of CMOS transistor.

3EC4-21	PCC	Electronics Devices Lab	MM:50	0L:0T:2P	1 credit

List of Experiments

Sr. No.	Name of Experiment
1.	Study the following devices: (a) Analog& digital multimeters (b) Function/ Signal generators (c) Regulated d. c. power supplies (constant voltage and constant current operations) (d) Study of analog and digital CRO, measurement of time period, amplitude, frequency & phase angle using Lissajous figures.
2.	Plot V-I characteristic of P-N junction diode & calculate cut-in voltage, reverse Saturation current and static & dynamic resistances.
3.	Plot the output waveform of half wave rectifier and effect of filters on waveform. Also calculate its ripple factor.
4.	Study bridge rectifier and measure the effect of filter network on D.C. voltage output & ripple factor.
5.	Plot and verify output waveforms of different clipper and clamper.
6.	Plot V-I characteristic of Zener diode
7.	Study of Zener diode as voltage regulator. Observe the effect of load changes and determine load limits of the voltage regulator
8.	Plot input-output characteristics of BJT in CB, CC and CE configurations. Find their h-parameters.
9.	Study of different biasing circuits of BJT amplifier and calculate its Q-point.
10.	Plot frequency response of two stage RC coupled amplifier & calculate its bandwidth .
11.	Plot input-output characteristics of field effect transistor and measure I_{dss} and V_p.
12.	Plot frequency response curve for FET amplifier and calculate its gain bandwidth product.

Course Outcome:

Course Code	Course Name	Course Outcome	Details
3EC4-21	Electronic Devices Lab	**CO 1**	Understand the characteristics of different Electronic Devices.
		CO 2	Verify the rectifier circuits using diodes and implement them using hardware.
		CO 3	Design various amplifiers like CE, CC, common source amplifiers and implement them using hardware and also observe their frequency responses
		CO 4	Understand the construction, operation and characteristics of JFET and MOSFET, which can be used in the design of amplifiers.
		CO 5	Understand the need and requirements to obtain frequency response from a transistor so that Design of RF amplifiers and other high frequency amplifiers is feasible

CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
3EC4-21 Electronic Devices Lab	CO 1	3	2	3	2	1							1
	CO 2	2	3	1	3	3							2
	CO 3	2	1	2	3	3							
	CO 4	3	2	3	2	2							1
	CO 5	3	2	1	2	2							

3: Strongly **2: Moderate** **1: Weak**

3EC4-22	PCC	Digital System Design Lab	MM:50	0L:0T:2P	1 credit

List of Experiments

S. No.	Name of Experiment
Part A: Combinational Circuits	
1.	To verify the truth tables of logic gates: AND, OR, NOR, NAND, NOR, Ex-OR and Ex-NOR
2.	To verify the truth table of OR, AND, NOR, Ex-OR, Ex-NOR logic gates realized using NAND & NOR gates.
3.	To realize an SOP and POS expression.
4.	To realize Half adder/ Subtractor& Full Adder/ Subtractor using NAND & NOR gates and to verify their truth tables
5.	To realize a 4-bit ripple adder/ Subtractor using basic Half adder/ Subtractor& basic Full Adder/ Subtractor.
6.	To design 4-to-1 multiplexer using basic gates and verify the truth table. Also verify the truth table of 8-to-1 multiplexer using IC
7.	To design 1-to-4 demultiplexer using basic gates and verify the truth table. Also to construct 1-to-8 demultiplexer using blocks of 1-to-4 demultiplexer
8.	To design 2x4 decoder using basic gates and verify the truth table. Also verify the truth table of 3x8 decoder using IC
9.	Design & Realize a combinational circuit that will accept a 2421 BCD code and drive a TIL -312 seven-segment display
Part B: Sequential Circuits	
10.	Using basic logic gates, realize the R-S, J-K and D-flip flops with and without clock signal and verify their truth table.
11.	Construct a divide by 2, 4 & 8 asynchronous counter. Construct a 4-bit binary counter and ring counter for a particular output pattern using D flip flop.
12.	Design and construct unidirectional shift register and verify the
13.	Design and construct BCD ripple counter and verify the function.
14.	Design and construct a 4 Bit Ring counter and verify the function
15.	Perform input/output operations on parallel in/Parallel out and Serial in/Serial out registers using clock. Also exercise loading only one of multiple values into the register using multiplexer.

Note: Minimum 6 experiments to be conducted from **Part-A**& 4 experiments to be conducted from **Part-B.**

Course Outcome:

Course Code	Course Name	Course Outcome	Details
3EC4-22	Digital System Design Lab	CO 1	
		CO 2	To minimize the complexity of digital logic circuits.
		CO 3	To design and analyse combinational logic circuits.
		CO 4	To design and analyse sequential logic circuits.
		CO 5	Able to implement applications of combinational & sequential logic circuits.

CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
3EC4-22 Digital System Design Lab	CO 1	3	3	1									1
	CO 2	3	3	2	1	1							1
	CO 3	3	3	3	2	3	1						2
	CO 4	3	3	3	2	3	1						2
	CO 5	3	3	3	3	3	3						3

3: Strongly **2: Moderate** **1: Weak**

3EC4-23	PCC	Signal Processing Lab	MM:50	0L:0T:2P	1 credit

List of Experiments

Sr. No.	Name of Experiment (Simulate using MATLAB environment)
1.	Generation of continuous and discrete elementary signals (periodic and non periodic) using mathematical expression.
2.	Generation of Continuous and Discrete Unit Step Signal.
3.	Generation of Exponential and Ramp signals in Continuous & Discrete domain.
4.	Continuous and discrete time Convolution (using basic definition).
5.	Adding and subtracting two given signals. (Continuous as well as Discrete signals)
6.	To generate uniform random numbers between (0, 1).
7.	To generate a random binary wave.
8.	To generate and verify random sequences with arbitrary distributions, means and variances for following: (a) Rayleigh distribution (b) Normal distributions: N(0,1). (c) Gaussion distributions: N (m, x)
9.	To plot the probability density functions. Find mean and variance for the above distributions

Course Outcome:

Course Code	Course Name	Course Outcome	Details
3EC4-23	Signal Processing Lab	CO 1	Able to generate different Continuous and Discrete time signals.
		CO 2	Understand the basics of signals and different operations on signals.
		CO 3	Develop simple algorithms for signal processing and test them using MATLAB
		CO 4	Able to generate the random signals having different distributions, mean and variance.
		CO 5	Design and conduct experiments, interpret and analyse data and report results.

CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
3EC4-23 Signal Processing Lab	CO 1	2		1		2							
	CO 2	3		1									
	CO 3	1	2	3	1	3							
	CO 4	2	1	1		2							
	CO 5	1	1	2	2	2							

3: Strongly **2: Moderate** **1: Weak**

3EC3-24	ESC	Computer Programming Lab-I	MM:50	0L:0T:2P	1 credit

1.	Write a simple C program on a 32 bit compiler to understand the concept of array storage, size of a word. The program shall be written illustrating the concept of row major and column major storage. Find the address of element and verify it with the theoretical value. Program may be written for arrays upto 4-dimensions.
2.	Simulate a stack, queue, circular queue and dequeue using a one dimensional array as storage element. The program should implement the basic addition, deletion and traversal operations.
3.	Represent a 2-variable polynomial using array. Use this representation to implement addition of polynomials.
4.	Represent a sparse matrix using array. Implement addition and transposition operations using the representation.
5.	Implement singly, doubly and circularly connected linked lists illustrating operations like addition at different locations, deletion from specified locations and traversal.
6.	Repeat exercises 2, 3 & 4 with linked structures.
7.	Implementation of binary tree with operations like addition, deletion, traversal.
8.	Depth first and breadth first traversal of graphs represented using adjacency matrix and list.
9.	Implementation of binary search in arrays and on linked Binary Search Tree.
10.	Implementation of insertion, quick, heap, topological and bubble sorting algorithms.

4EC2-01	BSC	Advance Engineering Mathematics-II	MM:150	3L:0T:0P	3 credits

Complex Variable – Differentiation: (8 lectures)
Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.
Complex Variable - Integration: (8 lectures)
Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof).
Applications of complex integration by residues: (4 lectures)
Evaluation of definite integral involving sine and cosine. Evaluation of certain improper integrals.
Theory of Random Variables: (8 lectures)
Random Variables: Discrete and Continuous random variables, Probability distribution function, conditional distribution. Mathematical Expectations: Moments, Moment Generating Functions, variance and correlation coefficients, Chebyshev's inequality, skewness and Kurtosis.
Basic Probability Distributions and Applied Statistics: (6 lectures)
Bernoulli trials, Binomial distribution, Normal Distribution, Poisson Distribution, Poisson approximation to the binomial distribution and their relations, Uniform distribution, Exponential distribution Correlation: Karl Pearson's coefficient, Rank correlation, Curve fitting (fitting of straight lines), Line of Regression.
Suggested Text/Reference Books
1. Murray Spiegel, John Schiller, Seymour Lipschutz; Schaum's Outline of Complex Variables; Schaum's Outlines series. 2. Murray Spiegel, John Schiller, Srinivasan; Schaum's Outline of Probability and Statistics; Schaum's Outlines series. 3. R.K. Jain and S.R.K. Iyengar; Advanced Engineering Mathematics, Narosa Publications.

4. Dennis G. Zill and Shanahan; Complex Analysis, Jones & Bartlett Publication.
5. Seymour Lipschutz and John J. Schiller; Introduction to Probability and Statistics; Schaum's Outline series.
6. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
7. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.
8. Sheldon M. Ross; Introduction to Probability and Statistics for Engineers and Scientists, Academic Press.
9. Dennis G. Zill and Warren S. Wright; Advanced Engineering Mathematics, Jones & Bartlett Learning.

4EC4-04	PCC	Analog Circuits	MM:200	3L:1T:0P	4 credits

Syllabus

Diode Circuits, Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.
High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.
Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators. Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load. Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR. OP-AMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation.
OP-AMP applications: review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop, design guidelines.
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.

Text/Reference Books:

1.	J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
2.	J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
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 College11 Publishing, Edition IV.
5.	Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition.

Course Outcome:

Course Code	Course Name	Course Outcome	Details
4EC4-04	Analog Circuits	**CO 1**	Understand the characteristics of diodes and transistors
		CO 2	Design and analyze various rectifier and amplifier circuits
		CO 3	Design sinusoidal and non-sinusoidal oscillators
		CO 4	Understand the functioning of OP-AMP and design OP-AMP based circuits
		CO 5	Understanding the designing of ADCs and DACs

CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
4EC4-04 Analog Circuits	**CO 1**	3		1	1	2							
	CO 2	1	1	2		1							
	CO 3	3	1		1								
	CO 4	2				2							
	CO 5	2	3		2								

3: Strongly **2: Moderate** **1: Weak**

Lecture Plan:

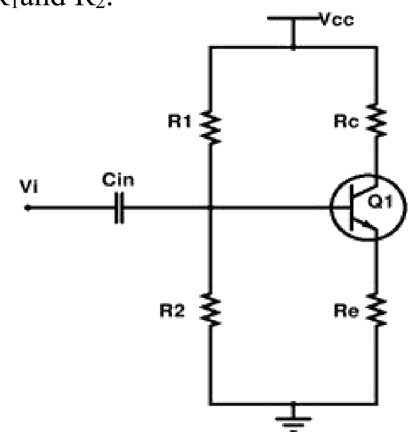
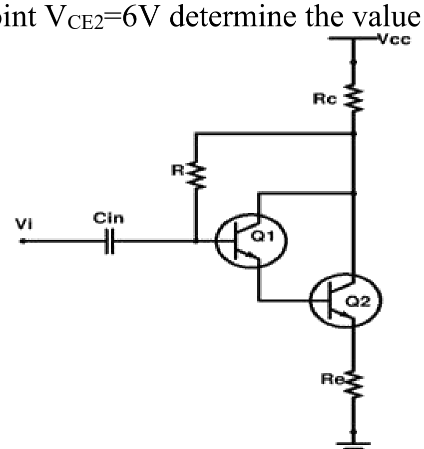
Lecture No.	Content to be taught
Lecture 1	Zero Lecture
Lecture 2	Diode Circuits and Amplifier models
Lecture 3	Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier
Lecture 4	Biasing schemes for BJT and FET amplifiers
Lecture 5	Bias stability in various configurations such as CE/CS, CB/CG, CC/CD
Lecture 6	Small signal analysis of BJT and FET
Lecture 7	low frequency transistor models
Lecture 8	Estimation of voltage gain, input resistance, output resistance etc.
Lecture 9	Design procedure for particular specifications, low frequency analysis of multistage amplifiers.
Lecture 10	High frequency transistor models
Lecture 11	frequency response of single stage and multistage amplifiers
Lecture 12	Cascode Amplifier
Lecture 13	Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues
Lecture 14	Feedback topologies: Voltage series, current series, voltage shunt, current shunt
Lecture 15	Effect of feedback on gain, bandwidth etc.,
Lecture 16	Calculation with practical circuits
Lecture 17	Concept of stability, gain margin and phase margin.
Lecture 18	Basics of oscillator
Lecture 19	Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.)
Lecture 20	LC oscillators (Hartley, Colpitt, Clapp etc.)
Lecture 21	Non-sinusoidal oscillators. Current mirror: Basic topology and its variants,

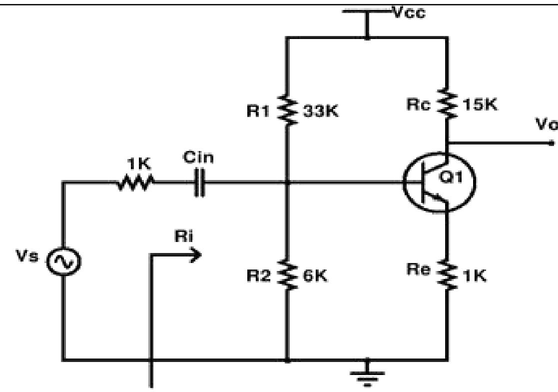
Lecture 22	V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load.
Lecture 23	Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR.
Lecture 24	OP-AMP design: design of differential amplifier for a given specification
Lecture 25	Design of gain stages and output stages, compensation
Lecture 26	OP-AMP applications: review of inverting and non-inverting amplifiers
Lecture 27	Integrator and differentiator, summing amplifier
Lecture 28	Precision rectifier, Schmitt trigger and its applications
Lecture 29	Active filters: Low pass, high pass
Lecture 30	Band pass and band stop Filters
Lecture 31	Filter Design guidelines
Lecture 32	Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc
Lecture 33	Analog to digital converters (ADC): Single slope, dual slope
Lecture 34	successive approximation, flash TYPE ADC
Lecture 35	Switched capacitor circuits: Basic concept
Lecture 36	Switched capacitor circuits: practical configurations
Lecture 37	Switched capacitor circuits: applications
Lecture 38	Spill over classes
Lecture 39	Spill over classes
Lecture 40	Spill over classes

Content delivery method:

1. Chalk and Duster
2. PPT
3. Hand-outs

Sample assignments:

Assignment 1	**Q1.** Assume that a silicon transistor with β =50, $V_{BEactive}$=0.7 V, V_{CC} =15V and R_C=10K is used in the Fig.1.It is desired to establish a Q-point at V_{CE}=7.5 V and I_C=5mA and stability factor S≤5.Find Re,$R_1$and R_2. 
	Q2. In the Darlington stage shown in Fig.2 , V_{CC}=15V , β_1=50, β_2=75,V_{BE}=0.7,R_C=750 Ω and R_E=100 Ω. If at the quiescent point V_{CE2}=6V determine the value of R. 
	Q3. For the amplifier shown in Fig.3 using a transistor whose parameters are h_{ie}=1100,h_{re}=2.5×$10^{-4,}$$h_{fe}$=50,$h_{oe}$=24µA/V.Find A_I, A_V, A_{VS} and R_i.

	
Assignment 2	**Q1.** Discuss the applications of operational amplifier.
	Q2. Discuss different types of filters.
	Q3. Discuss Dual counter type DAC and its applications

4EC4-05	PCC	Microcontrollers	MM:150	3L:0T:0P	3 credits

Syllabus

Overview of microcomputer systems and their building blocks, memory interfacing, concepts of interrupts and Direct Memory Access, instruction sets of microprocessors (with examples of 8085 and 8086);
Interfacing with peripherals - timer, serial I/O, parallel I/O, A/D and D/A converters; Arithmetic Coprocessors; System level interfacing design;
Concepts of virtual memory, Cache memory, Advanced coprocessor Architectures- 286, 486, Pentium; Microcontrollers: 8051 systems,
Introduction to RISC processors; ARM microcontrollers interface designs.

Text/Reference Books:

1.	R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996
2.	D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface. Morgan Kaufman Publishers.
3.	Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.
4.	Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996.

Course Outcome:

Course Code	Course Name	Course Outcome	Details
4EC4-05	Microcontrollers	CO 1	Develop assembly language programming skills.
		CO 2	Able to build interfacing of peripherals like, I/O, A/D, D/A, timer etc.
		CO 3	Develop systems using different microcontrollers.
		CO 4	Explain the concept of memory organization.
		CO 5	Understand RSIC processors and design ARM microcontroller based systems.

CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
4EC04-05 Microcontrollers	CO 1			3	1								
	CO 2			3		1							
	CO 3	1	2	3									
	CO 4	3	2	1									
	CO 5			3	2	1							

3: Strongly **2: Moderate** **1: Weak**

Lecture Plan:

Lecture No.	Content to be taught
Lecture 1	Zero Lecture
Lecture 2	Overview of microcomputer systems and their building blocks
Lecture 3	Overview of microcomputer systems and their building blocks
Lecture 4	Memory interfacing
Lecture 5	Memory interfacing
Lecture 6	Concepts of interrupts
Lecture 7	Direct Memory Access
Lecture 8	Direct Memory Access
Lecture 9	Instruction sets of microprocessors (with examples of 8085 and 8086)
Lecture 10	Instruction sets of microprocessors (with examples of 8085 and 8086)
Lecture 11	Instruction sets of microprocessors (with examples of 8085 and 8086)
Lecture 12	Instruction sets of microprocessors (with examples of 8085 and 8086)
Lecture 13	Interfacing with peripherals
Lecture 14	Timer
Lecture 15	Serial I/O
Lecture 16	Parallel I/O
Lecture 17	A/D and D/A converters;
Lecture 18	A/D and D/A converters
Lecture 19	Arithmetic Coprocessors
Lecture 20	System level interfacing design
Lecture 21	Concepts of virtual memory, Cache memory

Lecture 22	Concepts of virtual memory, Cache memory
Lecture 23	Advanced coprocessor Architectures- 286, 486, Pentium
Lecture 24	Advanced coprocessor Architectures- 286, 486, Pentium
Lecture 25	Advanced coprocessor Architectures- 286, 486, Pentium
Lecture 26	Microcontrollers: 8051 systems,
Lecture 27	Microcontrollers: 8051 systems,
Lecture 28	Microcontrollers: 8051 systems,
Lecture 29	Microcontrollers: 8051 systems,
Lecture 30	Microcontrollers: 8051 systems,
Lecture 31	Introduction to RISC processors
Lecture 32	Introduction to RISC processors
Lecture 33	Introduction to RISC processors
Lecture 34	ARM microcontrollers interface designs
Lecture 35	ARM microcontrollers interface designs
Lecture 36	ARM microcontrollers interface designs
Lecture 37	ARM microcontrollers interface designs
Lecture 38	ARM microcontrollers interface designs
Lecture 39	Spill Over Classes
Lecture 40	Spill Over Classes

Content delivery method:

1. Chalk and Duster
2. PPT
3. Hand-outs

Assignments:

Assignment 1	**Q1.** Compare between microprocessor & microcontroller based on no. of instructions used, registers, memory and applications.
	Q2. Interface external program memory with 8051 & explain how the data is transfer.
	Q3. List the I/O ports of microcontroller 8051. Explain their alternative function?
Assignment 2	**Q1.** Explain RISC and CISC?
	Q2. Without using MUL instruction, perform multiplication operation on any two operands, with both of them being: a. Positive numbers b. One positive and other negative number c. Both negative numbers Verify the values computed.
	Q3. Can you brief up the evolution of ARM architecture?

4EC3-06	ESC	Electronics Measurement & Instrumentation	MM:150	3L:0T:0P	3 credits

THEORY OF ERRORS - Accuracy & precision, Repeatability, Limits of errors, Systematic & random errors, Modeling of errors, Probable error & standard deviation, Gaussian error analysis, Combination of errors.
ELECTRONIC INSTRUMENTS - Electronic Voltmeter, Electronic Multimeters, Digital Voltmeter, and Component Measuring Instruments: Q meter, Vector Impedance meter, RF Power & Voltage Measurements, Introduction to shielding & grounding.
OSCILLOSCOPES – CRT Construction, Basic CRO circuits, CRO Probes, Techniques of Measurement of frequency, Phase Angle and Time Delay, Multibeam, multi trace, storage & sampling Oscilloscopes.
SIGNAL GENERATION AND SIGNAL ANALYSIS - Sine wave generators, Frequency synthesized signal generators, Sweep frequency generators. Signal Analysis - Measurement Technique, Wave Analyzers, and Frequency - selective wave analyser, Heterodyne wave analyser, Harmonic distortion analyser, and Spectrum analyser.
TRANSDUCERS - Classification, Selection Criteria, Characteristics, Construction, Working Principles and Application of following Transducers:- RTD, Thermocouples, Thermistors, LVDT, Strain Gauges, Bourdon Tubes, Seismic Accelerometers, Tachogenerators, Load Cell, Piezoelectric Transducers, Ultrasonic Flow Meters.

Text/Reference Books:

1. Electronic Instrument and Measurment, Bell, Oxford . 2007
2. Electronic Measurements & Instrumentation, Bernard Oliver, TMH. 1971
3. Electronic Instrumentation, H S Kalsi, TMH 2012
4. Instrumentation Measurement & Analysis, B.C.Nakra,K.K. Chaudhry, TMH 2004
5. Electronic Measurements and Instrumentation, Gupta & Soni, Genius pub. 2014.
6. Electronic Measurements & Instrumentation, Bernard Oliver, John Cage, TMH 1971
7. Electronic Measurements and Instrumentation, Lal Kishore, Pearson 2010
8. Elements of Electronic Instrumentation And Measurement, Carr, Pearson 1996
9. Instrumentation for Engineering Measurements, 2ed, Dally, Wiley 1993
10. Introduction To Measurements and Instrumetation, Arun K. Ghosh, PHI 2012

Course Outcome:

Course Code	Course Name	Course Outcome	Details
4EC3-06	ELECTRONIC MEASUREMENT & INSTRUMENTATION	CO 1	**Describe** the use of various electrical/electronic instruments, their block diagram, applications, dnd principles of operation, standards eorrs and units of measurements.
		CO 2	**Develop** basic skills in the design of electronic equipments
		CO 3	**Analyse** different electrical/electronic parameters using state of equipments of measuring instruments which is require to all types of industries.
		CO 4	**Solve** :Identify electronics/ electrical instruments, understanding associated with the instruments
		CO 5	**Explain** use of transducers in different types of field applications

CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
4EC3-06 ELECTRONIC MEASUREMENT & INSTRUMENTATION	**CO 1**	3	2	1									
	CO 2	2	2	2	3								
	CO 3	2	3										
	CO 4	2	1	1				2					
	CO 5	3	1										2

3: Strongly **2: Moderate** **1: Weak**

Lecture Plan:

Lecture No.	Content to be taught
Lecture 1	Zero Lecture
Lecture 2	Theory of errors
Lecture 3	Accuracy & precision, Repeatability
Lecture 4	Limits of Time-Hours errors
Lecture 5	Systematic & random errors
Lecture 6	Modeling of errors
Lecture 7	Probable error
Lecture 8	standard deviation
Lecture 9	Gaussian error analysis
Lecture 10	Combination of errors
Lecture 11	Electronic instruments - Electronic Voltmeter
Lecture 12	Electronic Multimeters
Lecture 13	Digital Voltmeter
Lecture 14	Component Measuring Instruments: Q meter
Lecture 15	Vector Impedance meter
Lecture 16	RF Power & Voltage Measurements
Lecture 17	Introduction to shielding & grounding
Lecture 18	Oscilloscopes - CRT Construction
Lecture 19	Basic CRO circuits, CRO Probes
Lecture 20	Techniques of Measurement of frequency, Phase Angle and Time Delay
Lecture 21	Multibeam, multi trace, storage & sampling Oscilloscopes
Lecture 22	Multibeam, multi trace, storage & sampling Oscilloscopes
Lecture 23	Signal generation and signal analysis - Sine wave generators,
Lecture 24	Frequency synthesized signal generators
Lecture 25	Sweep frequency generators
Lecture 26	Signal Analysis - Measurement Technique
Lecture 27	Wave Analyzers, and Frequency - selective wave analyser
Lecture 28	Heterodyne wave analyser
Lecture 29	Harmonic distortion analyser
Lecture 30	Spectrum analyser
Lecture 31	Transducers – Classification
Lecture 32	Selection Criteria Characteristics
Lecture 33	Construction, Working Principles and Application of following Transducers:- RTD
Lecture 34	Thermocouples
Lecture 35	Thermistors
Lecture 36	LVDT Strain Gauges, Bourdon Tubes

Lecture 37	Seismic Accelerometers
Lecture 38	Tachogenerators, Load Cell,
Lecture 39	Piezoelectric Transducers
Lecture 40	Ultrasonic Flow Meters

Content delivery method:

1. Chalk and Duster
2. PPT
3. Hand-outs

Sample assignments:

Assignment 1	**Q1.**	Write the principal of an AC Bridge used for the measurement of Unknown capacitor
	Q2.	Distinguish Between Accuracy and Precision?
	Q3.	Explain flow measurement with a suitable example.
Assignment 2	**Q1.**	What are primary sensing elements and transducers?
	Q2.	A Wheatstone Bridge requires to change of 7Ω in unknown arm of bridge to change in deflection of 14 mm. of galvanometer deter mine the sensitivity and deflection factor.
	Q3.	Explain the terms static error, static correction, relative error and percentage relative error.

4EC4-07	PCC	Analog and Digital Communication	MM:200	3L:1T:0P	4 credits

Syllabus

Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.
Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation.
Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.
Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion. Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.
Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.

Text/Reference Books:

1.	Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2.	Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3.	Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4.	Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.
5.	Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6.	Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

Course Outcome:

Course Code	Course Name	Course Outcome	Details
4EC4-07	Analog and Digital Communication	CO 1	Analyze and compare different analog modulation schemes for their efficiency and bandwidth
		CO 2	Analyze the behavior of a communication system in presence of noise
		CO 3	Investigate pulsed modulation system and analyze their system performance
		CO 4	Analyze different digital modulation schemes and can compute the bit error performance
		CO 5	Design a communication system comprised of both analog and digital modulation techniques

CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
4EC4-07 Analog & Digital Communication	CO 1	3	3		3		1				1		
	CO 2	3	2		3		1						
	CO 3	3	2		3		2						
	CO 4	3	3		3		2				1		
	CO 5	3	2	3	3		3			2	2		

3: Strongly **2: Moderate** **1: Weak**

Content delivery method:

1. Chalk and Duster
2. PPT

Lecture Plan:

Lecture No.	Content to be taught
Lecture 1	Introduction to the COURSE
Lecture 2	Review of signals and systems, Frequency domain representation of signals
Lecture 3	Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations
Lecture 4	Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations
Lecture 5	Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations
Lecture 6	Angle Modulation, Representation of FM and PM signals
Lecture 7	Angle Modulation, Representation of FM and PM signals
Lecture 8	Spectral characteristics of angle modulated signals.
Lecture 9	Review of probability and random process
Lecture 10	Review of probability and random process
Lecture 11	Noise in amplitude modulation systems
Lecture 12	Noise in amplitude modulation systems
Lecture 13	Noise in Frequency modulation systems
Lecture 14	Pre-emphasis and Deemphasis
Lecture 15	Threshold effect in angle modulation
Lecture 16	Pulse modulation. Sampling
Lecture 17	Pulse Amplitude and Pulse code modulation (PCM)
Lecture 18	Pulse Amplitude and Pulse code modulation (PCM)
Lecture 19	Differential pulse code modulation
Lecture 20	Delta modulation
Lecture 21	Noise considerations in PCM
Lecture 22	Time Division multiplexing, Digital Multiplexers
Lecture 23	Elements of Detection Theory
Lecture 24	Optimum detection of signals in noise
Lecture 25	Coherent communication with waveforms- Probability of Error evaluations

Lecture 26	Coherent communication with waveforms- Probability of Error evaluations
Lecture 27	Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion
Lecture 28	Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion
Lecture 29	Pass band Digital Modulation schemes
Lecture 30	Phase Shift Keying
Lecture 31	Frequency Shift Keying
Lecture 32	Quadrature Amplitude Modulation
Lecture 33	Continuous Phase Modulation and Minimum Shift Keying.
Lecture 34	Digital Modulation tradeoffs
Lecture 35	Optimum demodulation of digital signals over band-limited channels
Lecture 36	Optimum demodulation of digital signals over band-limited channels
Lecture 37	Maximum likelihood sequence detection (Viterbi receiver)
Lecture 38	Equalization Techniques
Lecture 39	Synchronization and Carrier Recovery for Digital modulation
Lecture 40	Synchronization and Carrier Recovery for Digital modulation

Assignments:

Assignment 1	**Q1.** Design Modulator and Demodulator of SSB-SC Modulation based on its mathematical expression.
	Q2. Derive the figure of merit in a) FM Receiver b) PM Receiver
	Q3. A Carrier signal c(t) = 20 cos ($2\pi 10^6 t$) is modulated by a message signal having three frequencies 5 KHz, 10 KHz & 20 KHz. The corresponding modulation indexes are 0.4, 0.5 & 0.6. Sketch the spectrum. Calculate bandwidth, power and efficiency.
Assignment 2	**Q1.** Derive the expression for probability of error in ASK, FSK and PSK systems and compare them.
	Q2. With block diagrams explain about DPCM & DM. also compare

	them.
	Q3. A message signal $m(t) = 4 \cos(2\pi 10^3 t)$ is sampled at nyquist rate and transmitted through a channel using 3-bit PCM system. i. Calculate all the parameters of the PCM. ii. If the sampled values are 3.8, 2.1, 0.5, -1.7, -3.2 & -4 then determine the quantizer output, encoder output and quantization error per each sample. iii. Sketch the transfer characteristics of the quantizer.

4EC4-21	PCC	Analog and Digital Communication Lab	MM:75	0L:0T:3P	1.5 credit

List of Experiments

Sr. No.	Name of Experiment
1.	Observe the Amplitude modulated wave form & measure modulation index and demodulation of AM signal.
2.	Harmonic analysis of Amplitude Modulated wave form.
3.	Generation & Demodulation of DSB – SC signal.
4.	Modulate a sinusoidal signal with high frequency carrier to obtain FM signal and demodulation of the FM signal.
5.	Verification of Sampling Theorem.
6.	To study & observe the operation of a super heterodyne receiver.
7.	PAM, PWM & PPM: Modulation and demodulation.
8.	To observe the transmission of four signals over a single channel using TDM-PAM method.
9.	To study the PCM modulation & demodulation and study the effect of channel like attenuation, noise in between modulator & demodulator through the experimental setup.
10.	To study the 4 channel PCM multiplexing & de-multiplexing in telephony system.
11.	To study the Delta & Adaptive delta modulation & demodulation and also study the effect of channel like attenuation, noise in between modulator & demodulator through the experimental setup.
12.	To perform the experiment of generation and study the various data formatting schemes (Unipolar, Bipolar, Manchester, AMI etc.)
13.	To perform the experiment of generation and detection of ASK, FSK, BPSK, DBPSK signals with variable length data pattern.

Course Outcome:

Course Code	Course Name	Course Outcome	Details
4EC4-21	Analog and Digital Communication Lab	CO 1	Understand different analog modulation schemes and evaluate modulation index
		CO 2	Able to understand the principle of superhetrodyne receiver
		CO 3	Develop time division multiplexing concepts in real time applications
		CO 4	Develop and able to comprehend different data formatting schemes
		CO 5	Comprehend and analyze the concepts of different digital modulation techniques in communication.

CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
4EC4-21 Analog and Digital Communication Lab	CO 1	3	2		1								
	CO 2	3	2	1									
	CO 3	3	3	2	2	1							
	CO 4	3	3	2	2	1							
	CO 5	3	3	2	2	1							

3: Strongly **2: Moderate** **1: Weak**

4EC4-22	**PCC**	**Analog Circuits Lab**	**MM:150**	**0L:0T:3P**	**1.5 credit**

List of Experiments

Sr. No.	**Name of Experiment**
1.	Study and implementation of Voltage Series and Current Series Negative Feedback Amplifier.
2.	Study and implementation of Voltage Shunt and Current Shunt Negative Feedback Amplifier.
3.	Plot frequency response of BJT amplifier with and without feedback in the emitter circuit and calculate bandwidth, gain bandwidth product with and without negative feedback.
4.	Study and implementation of series and shunt voltage regulators and calculate line regulation and ripple factor.
5.	Plot and study the characteristics of small signal amplifier using FET.
6.	Study and implementation of push pull amplifier. Measure variation of output power & distortion with load and calculate the efficiency.
7.	Study and implementation of Wein bridge oscillator and observe the effect of variation in oscillator frequency.
8.	Study and implementation of transistor phase shift oscillator and observe the effect of variation in R & C on oscillator frequency and compare with theoretical value.
9.	Study and implementation of the following oscillators and observe the effect of variation of capacitance on oscillator frequency: (a) Hartley (b) Colpitts.
10.	Study and implementation of the Inverting And Non-Inverting Operational Amplifier.
11.	Study and implementation of Summing, Scaling And Averaging of Operational Amplifier
12.	Implementation of active filters using OPAMP.

Course Outcome:

Course Code	Course Name	Course Outcome	Details
4EC4-22	Analog Circuits Lab	CO 1	Discuss and observe the operation of a bipolar junction transistor and field-effect transistor in different region of operations.
		CO 2	Analyze and design of transistor Amplifier and Oscillators. Importance of negative feedback.
		CO 3	Analyze the frequency response of amplifiers and operational amplifier circuits. Develop an intuition for analog circuit behavior in both linear and nonlinear operation.
		CO 4	Design op-amps for specific gain, speed, or switching performance. Compensate operational amplifiers for stability.
		CO 5	Design and conduct experiments, interpret and analyze data, and report results.

CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
4EC4-22 Analog Circuits Lab	CO 1	3	2	1	2	2							
	CO 2	2	3	1	2	3							
	CO 3	1	3	2	3	2							
	CO 4	1	2	3	2	3							
	CO 5	1	2	3	3	3							

3: Strongly **2: Moderate** **1: Weak**

4EC4-23	PCC	Microcontrollers Lab	MM:50	0L:0T:2P	1 credit

List of Experiments

Sr. No.	**Name of Experiment**
Following exercises has to be Performed on 8085	
1.	Write a program for 1.1 Multiplication of two 8 bit numbers 1.2 Division of two 8 bit numbers
2.	Write a program to arrange a set of data in Ascending and Descending order.
3.	Write a program to find Factorial of a given number.
4.	Write a program to generate a Software Delay. 4.1 Using a Register 4.2 Using a Register Pair
8085 Interfacing Programs	
5.	5.1 Write a program to Interface ADC with 8085.
	5.2 Write a program to interface Temperature measurement module with 8085.
6.	Write a program to interface Keyboard with 8085.
7.	Write a program to interface DC Motor and stepper motor with 8085.
Following exercises has to be Performed on 8051	
8.	Write a program to convert a given Hex number to Decimal.
9.	Write a program to find numbers of even numbers and odd numbersamong 10 Numbers.
10.	Write a program to find Largest and Smallest Numbers among 10 Numbers.
11.	11.1 To study how to generate delay with timer and loop.
	11.2 Write a program to generate a signal on output pin using timer.
8051 Interfacing Programs	
12	12.1 Write a program to interface Seven Segment Display with 8051.
	12.2 Write a program to interface LCD with 8051.
13	Write a program for Traffic light Control using 8051.
14	Write a program for Elevator Control using 8051.

Course Outcome:

Course Code	Course Name	Course Outcome	Details
4EC4-23	Microcontrollers Lab	CO 1	Develop skills related to assembly level programming of microprocessors and microcontroller.
		CO 2	Interpret the basic knowledge of microprocessor and microcontroller interfacing, delay generation, waveform generation and Interrupts.
		CO 3	Interfacing the external devices to the microcontroller and microprocessor to solve real time problems.
		CO 4	Illustrate functions of various general purpose interfacing devices.
		CO 5	Develop a simple microcontroller and microprocessor based systems

CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
4EC4-23 Microcontrollers Lab	CO 1	2	1	2	1	3							
	CO 2	3	2	1	2	1							
	CO 3	1	1	3	1	3							
	CO 4	2	2	1									
	CO 5	1	1	3	2	2		2					

3: Strongly **2: Moderate** **1: Weak**

4EC4-24	PCC	Electronics Measurement & Instrumentation Lab	MM:50	0L:0T:2P	1 credit

List of Experiments

Sr. No.	Name of Experiment
1.	Measure earth resistance using fall of potential method.
2.	Plot V-I characteristics & measure open circuit voltage & short circuit current of a solar panel.
3.	Measure unknown inductance capacitance resistance using following bridges (a) Anderson Bridge (b) Maxwell Bridge
4.	To measure unknown frequency & capacitance using Wein's bridge.
5.	Measurement of the distance with the help of ultrasonic transmitter & receiver.
6.	Measurement of displacement with the help of LVDT.
7.	Draw the characteristics of the following temperature transducers (a) RTD (Pt-100) (b) Thermistors.
8.	Draw the characteristics between temperature & voltage of a K type thermocouple
9.	Calibrate an ammeter using D.C. slide wire potentiometer
10.	Measurement of strain/force with the help of strain gauge load cell.
11.	Study the working of Q-meter and measure Q of coils.
12.	Calibrate a single-phase energy meter (Analog and Digital) by phantom loading at different power factor by: (i) Phase shifting transformer (ii) Auto transformer.

Course Outcome:

Course Code	Course Name	Course Outcome	Details
4EC4-24	Electronic Measurement & Instrumentation Lab	CO 1	Understanding of the fundamentals of Electronic Instrumentation. Explain and identify measuring instruments.
		CO 2	Able to measure resistance, inductance and capacitance by various methods.
		CO 3	Design an instrumentation system that meets desired specifications and requirements.
		CO 4	Design and conduct experiments, interpret and analyze data, and report results.
		CO 5	Explain the principle of electrical transducers. Confidence to apply instrumentation solutions for given industrial applications.

CO-PO Mapping:

Subject	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
4EC4-24 Electronic Measurement & Instrumentation Lab	**CO 1**	3	2	1	2	2							
	CO 2	2	3	1	2	3							
	CO 3	1	3	2	3	2							
	CO 4	1	2	3	2	3							
	CO 5	1	2	3	3	3							

3: Strongly **2: Moderate** **1: Weak**