SCHEME OF INSTRUCTION & EXAMINATION
B.E. IV – Semester
(ELECTRONICS AND COMMUNICATION ENGINEERING)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1.	BS 405 MT	Applied Mathematics	3	1	-	4	30	70	3	3
2.	PC 401 EC	Analog Electronic Circuits	3	1	-	4	30	70	3	3
3.	PC 402 EC	Pulse, Digital and Integrated Circuits	3	1	-	4	30	70	3	3
4.	PC 403 EC	Probability Theory and Stochastic Process	3	1	-	4	30	70	3	3
5.	PC 404 EC	Electromagnetic Theory and Transmission Lines	3	1	-	4	30	70	3	3
6.	MC 916CE	Environmental Sciences	3	-	-	3	30	70	3	3
Practical / Laboratory Courses										
7.	PC 451 EC	Analog Electronic Circuits Lab	-	-	2	2	25	50	3	1
8.	PC 452 EC	Pulse, Digital and Integrated Circuits Lab	-	-	2	2	25	50	3	1
			18	**05**	**04**	**27**	**230**	**520**		**20**

Engineering Service Courses Offered to other Departments

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1.	ES934EC	Basic Electronics (For ME & PE)	3	-	-	3	30	70	3	3
2.	ES422EC	Signals & System Analysis (For CSE)	3	-	-	3	30	70	3	3
Practical / Laboratory Courses										
3.	ES955EC	Basic Electronics Lab (For ME & PE)	-	-	2	2	25	50	3	1

BS: Basic Sciences ES: Engineering Sciences MC: Mandatory Course
PC: Professional Course HS: Humanities and Sciences
L: Lectures T: Tutorials Pr : Practicals Drg: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour
2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

Course Code	Course Title						Core / Elective
BS405MT	**APPLIED MATHEMATICS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	1	-	-	**30**	**70**	**3**

Course Objectives

- To understand curve fitting, correlation and regression
- To introduce the concept of vector spaces and linear transformations
- To introduce a few numerical methods to solve certain types of problems

Course Outcomes

- Represent linear transformation by matrices
- Apply numerical methods and curve fitting to solve linear system of equations
- Explain optimization methods

UNIT- I

Linear Algebra:

Vector spaces, Subspaces, Basis and dimension, Linear transformations and their representation by matrices, Rank and Nullity of transformation.

UNIT- II

Numerical methods I:

Solution of Algebraic and Transcendental equations-Bisection method, Regula falsi method, Newton-Raphson method, Solution of linear system of equations, Gauss elimination method, Gauss- Seidel iteration method, Interpolation, Lagrange's interpolation, Newton's divided difference interpolation, Newton's Forward and Backward difference interpolations.

UNIT- III

Numerical methods II:

Numerical differentiation, Interpolation approach, Numerical solutions of ordinary differential equations Single step methods, Taylor's series method, Euler method, Picard's method of successive approximation, Runge-Kutta method of 4^{th} order, Multi step methods, Predictor-Corrector method, Euler PC method, Miline and Adams Moulton PC method.

UNIT-I V

Curve fitting:

Curve fitting by method of least squares**,** correlation and regression, types of correlations, Karl Pearson's coefficient of correlation, Spearman's rank correlation coefficient, equal ranks, equations to the lines of regression.

UNIT- V

Optimization:

Basic Concepts, Unconstrained Optimization, Linear Programming, Simplex method, Simplex Method: Difficulties.

Suggested Readings:

1. R.K.Jain & S.R.K Iyengar**, Advanced Engineering Mathematics**, Narosa Publications,
1. 4th Edition, 2014.
2. B.S.Grewal, **Higher Engineering Mathematics**, Khanna Publications, 43rd Edition,2014.
3. Gupta & Kapoor, **Fundamentals of Mathematical statistics**, Sultan chand & sons, New Delhi, 2014.
4. Erwin Kreyszig**, Advanced Engineering Mathematics,** John Wiley & Sons, 9th Edition, 2012.
5. S.C.Gupta and V.K.Kapoor, **Fundamentals of Mathematical Statistics**, Sultan Chand& Sons, 2014.

Course Code	Course Title						Core / Elective
PC401EC	**ANALOG ELECTRONIC CIRCUITS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	1	-	-	**30**	**70**	**3**

Course Objectives

- Analyze frequency response of Amplifiers in different frequency ranges.
- Familiarize with concept and effect of negative feedback
- Study positive feedback and Design different types of oscillators.
- Design Power Amplifiers and calculate their efficiencies.
- Familiarize with concept of tuned Amplifiers.

Course Outcomes

- Design and develop small signal amplifiers, power amplifiers, feedback amplifiers and oscillators.
- Estimate gain-bandwidth product of amplifiers
- Design voltage regulator circuits

UNIT-I

Small Signal Amplifiers:

Introduction to Hybrid-pi model, relationship between hybrid-pi & h-parameter model; Classification of amplifiers, mid-frequency, Low-frequency and high frequency analysis of single and multistage RC coupled amplifier with BJT and FET. Analysis of transformer coupled amplifier in mid frequency, Low frequency and high frequency regions with BJT.

UNIT-II

Feedback Amplifiers: The feedback concept, General characteristics of negative feedback amplifier, Effect of negative feedback on input and output impedances, Voltage and current, series and shunt feedbacks. Stability considerations, Local Versus global feedback

UNIT-III

Oscillators: Positive feedback and conditions for sinusoidal oscillations, RC oscillators, LC oscillators, Crystal oscillator, Amplitude and frequency stability of oscillator.

Regulators: Transistorized series and shunt regulators

UNIT-IV

Large Signal Amplifiers: BJT as large signal audio amplifiers, Classes of operation, Harmonic distortion, power dissipation, efficiency calculations. Design considerations of transformer coupled and transform less push-pull audio power amplifiers under Class-A. Class-B, Class D and Class-AB operations

UNIT-V

RF Voltage Amplifiers: General consideration, Analysis and design of single tuned and double tuned amplifiers with BJT, Selectivity, gain and bandwidth. Comparison of multistage, single tuned amplifiers and double tuned amplifiers. The problem of stability in RF amplifiers, neutralization & uni-laterisation, introduction to staggered tuned amplifiers.

Suggested Readings:

1. Jacob Millman, Christos C. Halkias, and Satyabrata Jit**, Electronic Devices and Circuits**, 3rd ed., McGraw Hill Education, 2010.
2. David A. Bell, **Electronic Devices and Circuits,** 5th ed., Oxford University Press, 2009.
3. S Salivahanan, N Kumar, and A Vallavaraj, **Electronic Devices and Circuits,** 2nd ed., McGraw Hill Education, 2007.

Course Code	Course Title						Core / Elective
PC402EC	**PULSE, DIGITAL & INTEGRATED CIRCUITS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	1	-	-	**30**	**70**	**3**

Course Objectives

- To analyze linear wave shaping circuits and plot the response for various input waveforms.
- To design and analyze non-linear circuits like clippers and clampers.
- To analyze and design transistor multivibrators, time base generators and sweep circuits using discrete components and analyze voltage and current sweep circuits and identify methods to mitigate sweep errors.
- To classify different ICs, calculate IC characteristics and analyze basic gates with DTL, TTL, ECL, logic family and design their interfacing circuits.
- To build basic gates with MOS and CMOS logic family and design their interfacing circuits.

Course Outcomes

- Design and develop linear, non-linear wave shaping multi-vibrator circuits.
- Analyze time-base generator circuits
- Explain digital logic families

UNIT I: Linear wave shaping:

High pass, low pass RC circuits, their response for sinusoidal, step, pulse, square and ramp inputs. RC network as differentiator and integrator, attenuators, RL and RLC circuits and their response for step input.

UNIT II: Non-linear wave shaping:

Diode clippers, Transistor clippers, clipping at two independent levels, Transfer chracteristics of clippers, Emitter coupled clipper, Comparators,Applications of voltageco mparators, clamping operation,Clamping circuits using diode with different inputs, Clamping circuit theorem, practical clamping circuits, Transfer characteristics of clampers. Transistor as a switch, Design of transistor switch, transistor-switching times.

UNIT III: Multi-vibrators:

Design and Analysis of Bistable, Monostable, Astable Multivibrators and Schmitt trigger using transistors,

Time base generators: General features of a time base signal, Speed, transmission and displacement errors. Analysis and Design of Sweep circuits using UJT and SCR.

UNIT IV:

Manufacturer's designations for integrated circuits, Integrated circuit package types, Pin identifications and temperature ranges, IC characteristics, Logic Families: DTL, TTL logic family, TTL series, output configuration: Open collector, Totem pole, Tri state logic. ECL logic Family

UNIT V:

MOS logic Family (PMOS and NMOS), CMOS logic family and characteristics, CMOS transmission gate (bilateral switch) and its applications, CMOS open drain and high impedance output, CMOS inverter, NAND and NOR gates, Interfacing CMOS and TTL, Comparison of TTL, CMOS and ECL logic families.

Suggested Readings

1. J. Millman, H. Taub and S Rao, **Pulse, Digital and Switching Waveforms**, 3rd edition, McGraw-Hill, 2014.
2. David A. Bell, **Pulse, Switching and Digital Circuits**, 5th edition, Oxford University Press, 2015.
3. R. P Jain, **Modern Digital Electronics**,4th ed., McGraw Hill Education (India) Private Limited, 2003

Course Code	Course Title						Core / Elective
PC403EC	**PROBABILITY THEORY AND STOCHASTIC PROCESS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	1	-	-	**30**	**70**	**3**

Course Objectives

- To understand different types of Random variables their density distribution functions
- To learn one Random variable characteristic functions of different variables using their density functions
- To learn the concepts of sequences of Random variables, Properties of Random vectors
- To understand elementary concepts of the Random Processes or distribution functions
- To understand the functions of two Random variables probability density distribution of the joint Random variables

Course Outcomes

- Apply probability and random variables
- Explain temporal and spectral functions of random variables
- Analyze the noise

UNIT-I: Probability and Random Variable

Probability: Probability introduced through Sets and Relative Frequency, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem, Independent Events.

Random Variable: Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete, Continuous and Mixed Random Variables.

UNIT -II: Distribution & Density Functions and Operation on One Random Variable – Expectations

Distribution & Density Functions: Distribution and Density functions and their Properties - Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh and Conditional Distribution, Methods of defining Conditional Event, Conditional Density, Properties.

Operation on One Random Variable – Expectations: Introduction, 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.

UNIT-III: Multiple Random Variables and operations

Multiple Random Variables: Joint Distribution Function and its Properties Joint Density Function and its Properties, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Conditional Distribution and Density – Interval conditioning, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem (Proof not expected), Unequal Distribution, Equal Distributions.

Operations on Multiple Random Variables:

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.

UNIT-IV: **Random Processes – Temporal Characteristics:**

The Stochastic 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, Nth 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 and its Properties, Linear System Response of Mean and Mean-squared Value, Autocorrelation Function, Cross-Correlation Functions, Gaussian Random Processes, Poisson Random Process.

UNIT-V: Random Processes – **Spectral Characteristics:**

The Power Density Spectrum and its Properties, Relationship between Power Spectrum and Autocorrelation Function, Cross-Power Density Spectrum and its Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function, Some Noise Definitions and Other Topics: White Noise and Colored Noise, Product Device Response to a Random Signal. Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Spectral Density of Input and Output of a Linear System.

SUGGESTED READINGS:

1. Peyton Z. Peebles, **Probability, Random Variables & Random Signal Principles**, 4th edition, Tata McGraw Hill, 2001.
2. Athanasius Papoulis and S. Unnikrishna Pillai, **Probability, Random Variables and Stochastic Processes,** 4th edition, McGraw Hill, 2006.
3. Henry Stark and John W. Woods, **Probability and Random Processes with Application to Signal Processing,** 3rd edition, Pearson Education, 2014.
4. P. Ramesh Babu, **Probability Theory and Random Processes**, 1st edition, McGraw Hill Education (India) Private Limited, 2015.

Course Code	Course Title						Core / Elective
PC404EC	**ELECTROMAGNETIC THEORY AND TRANSMISSION LINES**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	1	-	-	**30**	**70**	**3**

Course Objectives

- Analyze fundamental concepts of vector analysis, electrostatics and magneto statics law and their applications, transmission lines and their characteristics
- Describe the relationship between Electromagnetic Theory and circuit theory
- Formulate the basic laws of static electricity and magnetism and extend them to time varying fields
- Define the Maxwell's equations leading to the wave equations in various media and wave propagation characteristics.

Course Outcomes

- Apply Biot-Savart Law, Stoke's theorem, Ampere's theorem and Maxwell's equations
- Formulate the basic relationship between distortion less transmission lines & applications.
- Draw Smith chart and calculate VSWR

Unit – I

Review of coordinate systems. Coulomb's Law, Electric field due to various Charge configurations and Electric flux density. Gauss's Law and its applications. Work, Potential and Energy, The dipole. Current and Current density, Laplace and Poisson's equations. Calculation of capacitance for simple configurations.

Unit – II

Steady magnetic-Biot-Savart's law, Ampere's law. Stoke's theorem, Magnetic flux and magnetic flux density. Scalar and vector magnetic potentials. Electric and Magnetic fields boundary conditions. Maxwell's equations for static and time varying fields.

Unit – III

Uniform plane waves in free space and in conducting medium, Polarization. Instantaneous, average and complex Poynting theorem and its applications. Reflection: Normal incidence on dielectrics and conducting medium. Reflection: Oblique incidence on dielectrics and conducting medium,

Unit – IV

Concept of symmetrical network-T and π networks. Types of Transmission Lines-Two wire lines. Primary and secondary constants. Transmission Line equations. Infinite line and characteristic impedance- Open and short circuit lines and their significance. Distortion less transmission line, Concept of loading of a transmission line, Campbell's formula.

Unit – V

Imedance at any point on the transmission line- Input impedance. RF and UHF lines, transmission lines as circuit elements. Properties of λ/2, λ/4 and λ/8 Lines. Reflection and VSWR. Matching: Stub matching. Smith chart and its applications.

Suggested books:

1. Matthew N.O. Sadiku, **Principles of Electro-magnetics**, 6th edition, Oxford University Press, 2016
2. William H. Hayt Jr. and John A. Buck, **Engineering Electromagnetics**, 7th edition, Tata McGraw Hill, 2006
3. John D. Ryder, **Networks Lines and Fields**, 2nd edition, Pearson, 2015
4. E.C. Jordan and K.G. Balmain, **Electromagnetic Waves and Radiating Systems,** 2nd edition, Pearson, 2015
5. K.D.Prasad, **Antennas and Wave Propagation,** Khanna Publications.

Course Code	Course Title						Core / Elective
MC916CE	**ENVIRONMENTAL SCIENCES**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	**30**	**70**	**3**

Course Objectives

- To study the basic concepts, sources of water, floods and their impact on environment
- To know the ecosystems and energy resource systems
- To understand the Biodiversity concepts and their advantages
- To study the different pollutions and their impact on environment
- To know the social and environment related issues and their preventive measures

Course Outcomes

- Awareness of effects of hazardous environment.
- Idea about optimum utilization of natural resources.
- Be a catalyst in moving towards Green technologies
- Information about rules and regulations of pollution control

UNIT-I

Environmental Studies: Definition, scope and importance, need for public awareness.
Natural resources: Water resources; use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams:benefits and problems. Effects of modern agriculture, fertilizer- pesticide problems, water logging and salinity.

UNIT-II

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in ecosystem, food chains, ecological pyramids, aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries).
Energy resources: Growing energy needs, renewable and non-renewable energy sources. Land Resources, land as a resource, land degradation, soil erosion and desertification.

UNIT-III

Biodiversity: Genetic species and ecosystem diversity, bio-geographical classification of India. Value of biodiversity, threats to biodiversity, endangered and endemic species of India, conservation of biodiversity.

UNIT-IV

Environmental Pollution: Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution; solid and liquid waste management.

Environment Protection Act: Air, water, forest and wild life Acts, enforcement of environmental legislation.

UNIT-V

Social Issues and the Environment: Water conservation, watershed management, and environmental ethics. Climate change, global warming, acid rain, ozone layer depletion. **Environmental Disaster Management:** Types of disasters, impact of disasters on environment, infrastructure, and development. Basic principles of disaster mitigation, disaster management, and methodology. Disaster management cycle, and disaster management in India.

Suggested Reading:

1. A.K. De, **Environmental Chemistry**, Wiley Eastern Ltd.
2. E.P. Odum, **Fundamentals of Ecology**, W.B. Sunders Co., USA.
3. M.N. Rao and A.K. Datta , **Waste Water Treatment**, Oxford and IBK Publications.
4. Benny Joseph, **Environmental Studies**, Tata McGraw Hill, 2005.
5. V.K. Sharma, **Disaster Management,** National Centre for Disaster Management, IIPE,1999. Green Building Council of India, Teri Document.

Course Code	Course Title						Core / Elective
PC451EC	**ANALOG ELECTRONIC CIRCUITS LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	**25**	**50**	**1**

Course Objectives

- Design and analyze BJT, FET amplifiers and regulators
- Analyze Oscillator circuits
- Plot the frequency response of tuned amplifiers
- Understand filter circuits.

Course Outcomes

- Calculate gain and bandwidth of BJT, FET and tuned amplifiers and oscillator circuits
- Demonstrate regulator and filter circuits

List of Experiments

1. Two Stage R-C Coupled CE BJT Amplifier
2. Two Stage R-C Coupled CS FET Amplifier
3. Voltage Series Feedback Amplifier
4. Voltage Shunt Feedback Amplifier
5. Current Shunt Feedback Amplifier
6. RC Phase-Shift and Wein-bridge Oscillator
7. Hartley and Colpitts Oscillator
8. Design of Class-A power amplifier
9. Design of Class-B power amplifier
10. Frequency response of Tuned Amplifier
11. Transistor Regulator
12. Constant K Low Pass and High Pass Filter
13. m-Derived Low Pass and High Pass Filter

Note:

1. Atleast ten experiments should be conducted in the Semester..
2. It is mandatory to simulate a any three experiments using SPICE

Suggested Reading:

1. Paul B. Zbar, Albert P. Malvino, **Michael A. Miller, Basic Electronics**, *A Text - Lab Manual*, 7th Edition, TMH 2001.

Course Code	Course Title						Core / Elective
PC452EC	**PULSE, DIGITAL AND INTEGRATED CIRCUITS LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	**25**	**50**	**1**

Course Objectives

- To implement high pass and low pass circuit and study it's performance
- To implement clipping and clamping circuits and study it's performance
- To design and test bi-stable, mono-stable, astable multi-vibrators
- To study the characteristics of a Schmitt trigger
- To build sweep circuits and study it's performance

Course Outcomes

- Design and analyze linear and non-linear wave shaping circuits
- Demonstrate oscillator circuits

List of experiments

1. Low Pass and High pass RC circuits
2. Two level clipping circuits
3. Clamping circuits
4. Transistor Switching timer
5. Collector coupled Bistable Multivibrators
6. Collector coupled Monostable Multivibrators
7. Collector coupled Astable Multivibrators
8. Schmitt Trigger Circuit
9. Miller sweep circuit
10. Bootstrap sweep circuit
11. Astable Blocking Oscillator
12. U.J.T. (Relaxation) Sweep Generator

Suggested Reading:

1. Robert Boylestad and Louis Nashelsky, **"Electronic Devices and Circuit theory**", 5th Edition, Prentice-Hall of India Private Limited, New Delhi, 1995.
2. David A.Bell, "**Laboratory Manual for Electronic Devices and Circuits**", 4th Edition, Prentice-Hall of India Private Limited, New Delhi, 2004.

Course Code	Course Title						Core / Elective
ES934EC	**BASIC ELECTRONICS (For ME and PE)**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	**30**	**70**	**3**

Course Objectives

- Analyze the behavior of semiconductor diodes in Forward and Reverse bias.
- Design of Half wave and Full wave rectifiers with L, C, and LC & CLC Filters.
- Explore V-I characteristics of Bipolar Junction Transistor n CB, CE & CC configurations.
- Explain feedback concept and different oscillators.
- Analyze Digital logic basics and Photo Electric devices.

Course Outcomes

- Explain VI characteristics of Semiconductor diode, BJT, FET and MOSFET
- Calculate ripple factor, efficiency and % regulation of rectifier circuits
- Analyze feedback amplifiers, BJT oscillator circuits, Opamp, basic digital logic gates and data acquisition system

UNIT-I

Semi Conductor Theory: Energy Levels, Intrinsic and Extrinsic Semiconductors, Mobility, Diffusion and Drift current. Hall Effect, Characteristics of P-N Junction diode, Parameters and Applications

Rectifiers: Half wave and Full wave Rectifiers (Bridge, center tapped) with and without filters, ripple regulation and efficiency. Zener diode regulator.

UNIT-II

Bipolar Junction Transistor: BJT, Current components, CE, CB, CC configurations, characteristics, Transistor as amplifier. Analysis of CE, CB, CC Amplifiers (qualitative treatment only).

JFET: Construction and working, parameters, CS, CG, CD Characteristics, CS amplifier.

UNIT-III

Feedback Concepts – Properties of Negative Feedback Amplifiers, Classification, Parameters.

Oscillators – Barkhausen Criterion, LC Type and RC Type Oscillators and Crystal Oscillators. (Qualitative treatment only)

UNIT-IV

Operational Amplifiers – Introduction to OP Amp, characteristics and applications – Inverting and Non-inverting Amplifiers, summer, Integrator, Differentiator, Instrumentation Amplifier.

Digital Systems: Basic Logic Gates, half, Full Adder and Subtractors.

UNIT-V

Data Acquisition systems: Study of transducer (LVDT, Strain gauge, Temperature, Force). **Photo Electric Devices and Industrial Devices:** Photo diode, Photo Transistor, LED, LCD, SCR, UJT Construction and Characteristics only.

Display Systems: Constructional details of CRO and Applications.

Suggested Reading:

1. Jocob Millman, Christos C. Halkias and Satyabrata Jit, **Electronics Devices and Circuits,** 3rd edition, McGraw Hill Education(India) Private Limited, 2010.
2. Rama Kanth A. Gaykward, **Op-AMPS and Linear Integrated Circuits** 4th Edition Prentice Hall of India, 2000.
3. M. Morris Mano, **Digital Design**, 3rd Edition, Prentice Hall of India, 2002.
4. William D Cooper, and A.D. Helfrick, **Electronic Measurements and Instrumentations Techniques**, 2nd ed., Prentice Hall of India, 2008.
5. S. Shalivahan, N. Suresh Kumar, A. Vallava Raj, **Electronic Devices and Circuits**, 2nd ed., McGraw Hill Education(India) Private Limited, 2007.

Course Code	Course Title						Core / Elective
ES422EC	**SIGNALS AND SYSTEM ANALYSIS (For CSE)**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	**30**	**70**	**3**

Course Objectives

- To learn basic concepts related to signals & systems.
- To familiarize with basic operations on signals mathematical representation of periodic, aperiodic signals continuous discrete systems.
- To understand convolution, correlation operations on continuous signals.
- To analyze the response of systems on application of step, ramp inputs using Fourier & Z transforms.

Course Outcomes

- Apply Fourier series, Fourier transform, Laplace transform and Z-transform on signals and systems
- Apply linear convolution and discrete convolution on signals
- Explain discrete Fourier transform on signals and systems

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, Exponential and sinusoidal signals, Concepts of Impulse function, Unit step function, Signum function.

UNIT-II

Fourier Transform: Deriving Fourier transform from Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, Fourier transform of periodic signals, properties of Fourier transforms, 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, Linear time invariant (LTI) system, Linear time variant (LTV) system, Transfer function of a LTI system. Filter characteristics of linear systems. Distortion less transmission through a system, Signal bandwidth, system bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Poly-Wiener criterion for physical realization, relationship between bandwidth and rise time.

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UNIT–IV

Convolution & Correlation of Signals: Concept of convolution in time domain and frequency domain, Graphical representation of convolution, Convolution property of

Fourier transforms. Cross correlation and auto correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between auto correlation function and energy/power spectral density function.Relation between convolution and correlation, Detection of periodic signals in the presence of noise by correlation, Extraction of signal from noise by filtering.

UNIT- V

Z-Transform: Fundamental difference between continuous and discrete time signals, discrete time signal representation using complex exponential and sinusoidal components, Periodicity of discrete time using complex exponential signal, 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.

Suggested Reading:

1. Lathi B.P., **Signals Systems & Communications**, B.S. Publications, 1st Edition, 2006.
2. Alan V. Oppenheim, Alan.S.Willsky, S Hamid Nawab, **Signals Systems**, Prentice Hall of India, 2nd Edition, 2007.
3. Simon Haykin and Van Veen, **Signals and Systems** , Wiley India, 2nd Edition, 2008.

Course Code	Course Title						Core / Elective
ES955EC	**BASIC ELECTRONICS LAB (For ME and PE)**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	-	-	-	2	**25**	**50**	**1**

Course Objectives

- Demonstrate the characteristics of Semiconductor diodes
- Realize the filters and Rectifiers.
- Verify the characteristics of different transistor Configurations.
- Design of Biasing Circuits for BJT and FET Amplifiers.
- Design different circuits using Operational Amplifiers.

Course Outcomes

- Plot characteristics of diode and transistor
- Calculate ripple factor, efficiency and % regulation of rectifier circuits
- Analyze feedback amplifiers and BJT oscillator circuits
- Demonstrate Opamp, data converter and strain gauge measurement

List of Experiments:

1. CRO-Applications, Measurements of R, L and C using LCR meter, Colour code method soldering practice.
2. Characteristics of Semiconductors diode (Ge, Si and Zener).
3. Static characteristics of BJT-Common Emitter.
4. Static characteristics of BJT-Common Base.
5. Static characteristics of FET.
6. RC-Phase Shift Oscillator.
7. Hartley and Colpitt's Oscillators.
8. Common Emitter Amplifier.
9. Astable Multivibrator.
10. Full-wave rectifier with and without filters using BJT.
11. Operational Amplifier as Amplifier, Integrator.
12. Strain Gauge Measurement.
13. Analog-to-Digital and Digital to Analog Converters.

Suggested Reading:

1. David Bell A., **Operational Amplifiers and Linear ICS**, Prentice Hall of India, 2005.
2. David Bell A., **Laboratory for Electronic Devices and Circuits,** Prentice Hall of India, 2007.