204181: Signals and Systems

Teaching Scheme:
Lectures: 3 Hrs/Week
Tutorial: 1 Hr/Week

Examination Scheme:
Paper: 100 Marks
Oral: 50 Marks

Unit I: Introduction to Signals and Systems 6L

Definition of signals and systems, communication and control systems as examples, Classification of signals: Continuous time and discrete time, even, odd, periodic and non periodic, deterministic and non deterministic, energy and power.
Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (accumulator for DT), time scaling, time shifting and folding, precedence rule.
Elementary signals: exponential, sine, step, impulse and its properties, ramp, rectangular, triangular, signum, sinc.
Systems: Definition, Classification: linear and non linear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.

Unit II: System Analysis 8L

System modeling: Input output relation, impulse response, block diagram, integro-differential equation and state-space representation. Definition of impulse response, convolution integral, convolution sum, computation of convolution integral using graphical method for unit step to unit step, unit step to exponential, exponential to exponential and unit step to rectangular, rectangular to rectangular only. Computation of convolution sum by all methods. Properties of convolution, system interconnection, system properties in terms of impulse response, step response in terms of impulse response.

Unit III: System Analysis in Frequency Domain using Fourier Transform 6L

Definition and necessity of CT and DT Fourier series and Fourier transforms. Analogy between CTFS, DTFS and CTFT, DTFT. CT Fourier series, CT Fourier transform and its properties, problem solving using properties, amplitude spectrum, phase spectrum of the signal and system. Interplay between time and frequency domain using sinc and rectangular signals. Limitations of FT and need of LT and ZT.

Unit IV: System Analysis in Frequency Domain using Laplace Transform 6L

Definition and its properties, ROC and pole zero concept. Application of Laplace transforms to the LTI system analysis. Inversion using duality, numerical based on properties. Signal analysis using LT.

Unit V: Correlation and Spectral Density **4L**

Definition of Correlation and Spectral Density, correlogrm, analogy between correlation, covariance and convolution, conceptual basis, auto-correlation, cross correlation, energy/power spectral density, properties of correlation and spectral density, inter relation between correlation and spectral density.

Unit VI: Probability, Random Variables and Random Signals **6L**

Experiment, sample space, event, probability, conditional probability and statistical independence. Random variables: Continuous and Discrete random variables, cumulative distributive function, Probability density function, properties of CDF and PDF. Statistical averages, mean, moments and expectations, standard deviation and variance. Probability models: Uniform, Gaussian, Binomial. Evolution and definition of random signal through probability via random variable.

Text Books:

1. Simon Haykins and Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley India.
2. Simon Haykins, "Introduction to Analog and Digital Communications", Wiley India.

Reference Books:

1. B.P. Lathi, "Linear Systems and Signals", 2nd Edition, Oxford University Press, 2004.
2. Charles Phillips, "Signals , Systems and Transforms" , 3rd Edition, Pearson Education.
3. Peyton Peebles, "Probability, Random Variable, Random Processes", 4th Edition, Tata Mc Graw Hill.

Signals and Systems
(Tutorial Assignments)

Tutorials are to be conducted batch wise and Matlab based

1. A) Sketch and write defining mathematical expression for the following signals in CT and DT
   a) Unit Step.
   b) Rectangular
   c) Exponenetial
   d) Signum
   e) Sine
   f) SinC
   g) Traingular
   h) Unit Impulse.
   i) Unit Ramp

   B) Classify and find the respective value for the above signals
   Periodic / Non Periodic
   Energy / Power /Neither

2. Take any two CT and DT signals and perform the following operation
   Amplitude scaling, addition, multiplication, differentiation, integration (accumulator for DT), time scaling, time shifting and folding
3. Express any two system mathematical expressions in input output relation form and determine whether each one of them is, Memory less, Causal, Linear, Stable, Time in variant, Invertible
4. Express any two system mathematical expressions in impulse response form and determine whether each one of them is, Memory less, Causal, Linear, Stable, Time in variant, Invertible
5. State and prove the properties of Fourier Transform. Take rectangular and sinc signal as examples and demonstrate the applications of CTFT properties. And also demonstrate the interplay between the time and frequency domain.
6. State and prove the properties of Lapalce Transform. Take any example of a system in time domain and demonstrate the application of LT in system analysis
7. A) Find the following for the given energy signal
   a) Autocorrelation
   b) Energy from Autocorrelation
   c) Energy from definition
   d) Energy Spectral Density directly
   e) ESD from Autocorrelation

B) Find the following for the given power signal

f) Autocorrelation

g) Power from Autocorrelation

h) Power from definition

i) Power Spectral Density directly

j) PSD from Autocorrelation

8. A) List and Explain the properties of CDF & PDF, Suppose a certain random variable has the CDF

(Any example may be taken). Write the corresponding PDF and find the values of P(X$\leq$ x) and P$\left(a < X \leq b\right)$

B) Find mean, mean square , standard deviation , variance of X for a given PDF.

204182: Solid State Devices and Circuits

Teaching Scheme:	Examination Scheme:
Lectures: 4 Hrs/Week	Paper: 100 Marks
Practical: 2 Hr/Week	Practical: 50 Marks

Unit I: Diodes and Field Effect Transistors **6L**

Diode Circuit Analysis: Small signal and large signal diode models, DC load line.
Analysis of DC circuits using diodes. Photo diodes and applications. Switching diodes, its characteristics, specifications and applications. Fast recovery diodes.
MOSFETs : Basics of MOS Transistor Operation, Construction of n-channel E-MOSFET, E-MOSFET characteristics & parameters, non ideal voltage current characteristics viz. Finite output resistance, body effect, sub threshold conduction, breakdown effects and temperature effects, Introduction to MOSFET as basic element in VLSI.

Unit II: MOSFET Circuits **8L**

MOSFET DC Circuit Analysis: Common source circuit, Load Line & Modes of operation, Common MOSFET configurations: DC Analysis, constant current source biasing.
The MOSFET CS Small Signal Amplifier: Small Signal Parameters, Small Signal Equivalent Circuit, Modeling, Body effect, Analysis of CS amplifier. Introduction to BiCMOS Technology.
The MOSFET internal capacitances and high frequency model.
MOSFET in VLSI: V-I characteristic equation in terms of W/L ratio, MOSFET scaling and small geometry effects, MOSFET capacitances. Modeling MOS transistors using SPICE.
Comparison of FET with MOSFET and BJT w.r.t Device and Circuit Parameters.

Unit III: Bipolar Junction Transistor and Their Applications **8L**

BJT Biasing: Integrated Circuit biasing, Thermal stabilization, Thermal Runaway
BJT Small Signal Low Frequency Amplifiers: Small Signal Amplifier Performance in terms of h-parameters, Practical transistor amplifiers, method of deriving DC & AC Small signal equivalent circuit for given Amplifier, exact analysis of BJT CB, CC and CE Amplifiers only using h-Parameters, Comparison of CE, CC & CB Amplifier's performance parameters, need of multistage amplifiers, selection of configuration of transistors in multistage amplifiers, Multistage Amplifiers.

Unit IV: Frequency Response **6L**

Introduction, Basic concepts, Human ear response, Square wave testing of amplifiers, Analysis of output waveform, Bode Plots, Frequency Response of RC-Coupled Amplifier, Effects of coupling and bypass capacitors on frequency response, Gain bandwidth product (GBW), Effect of cascading on frequency response, Total frequency response of an amplifier and concept of dominant pole.
BJT High frequency, small signal amplifiers:
Behavior of transistor at high frequencies. Modified T equivalent circuit. High frequency hybrid-π CE amplifier model. CE short circuit current gains for T and hybrid-π models. Definitions and derivations for f_α, f_β and f_T.
Phototransistor, Hetrojunction Bipolar Transistor. Optocoupler and its applications.

Unit V: Feedback and Oscillators **8L**

Negative Feedback: Introduction, A generalized feedback amplifier, Four basic amplifier types and feedback topologies, desirable characteristics of four basic amplifiers Performance, improved input and output resistances, Generic method for analysis of feedback amplifiers, Voltage-series, Current-series, Voltage-shunt, Current-shunt Feedback Topologies , feedback amplifier circuits using FET and their analysis
Oscillators: Introduction, Stability of system with Feedback, Gain and phase margin, Positive feedback and oscillators, RC Oscillators, LC oscillators, Crystal oscillators, Frequency stability of oscillators, Crystal Clock.

Unit VI: Large Signal Low Frequency Amplifiers **6L**

Power BJTs, Power MOSFETs, Heat Sinks, Classes of Audio Power Amplifiers (Class A,B,AB,C,D), Analysis of Class A power amplifiers: Direct and transformer coupled power amplifier, Class B & AB Push-Pull and complimentary-symmetry stages, Distortions in amplifiers, Concept of Total Harmonic Distortion (THD).

List of Practicals:

1. Design, build and test a sensing circuit fro slotted disc used in RPM indicator. Measure RPM using oscilloscope.
2. Design and simulate a Single stage BJT amplifier, for given specifications.(DC & AC Analysis) (1 Turn)
3. Build and test above amplifier (in experiment no. 2). (2 Turns)
4. Configure the circuit build in experiment no. 3 for Current series feedback topology and compare practical results with theoretical analysis. (1 Turn)
5. Simulate Voltage-Series, Voltage-Shunt and Current-Shunt feedback topologies.(2 Turns)
6. Simulate any one RC and LC oscillator.(1 Turn)
7. Complimentary-symmetry power amplifier and its DC analysis. Measurement of efficiency. (1 Turn)
8. Study of P.A. system specifications and demonstration of the system. (1 Turn)

Text Books:

1) Donald Neamaen, “Electronic Circuit Analysis and Design”, 3rd Edition, TMH.
2) Millman, Halkias, “Integrated Electronics- Analog and Digital Circuits and Systems”, TMH.

Reference Books:

1) David A.Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford press
2) Boylstad,Nashlesky, “Electronic Devices and Circuits Theory”,9th Edition, PHI, 2006.
3) Pucknell, Kamran, “Basic VLSI Design”, 3rd Edition, PHI, 1994.
4) Sedra/ Smith, “Microelectronics Circuits, 5th Edition, Oxford, 1999.

204183: Network Analysis

Teaching Scheme:
Lectures : 4 hrs/week

Examination Scheme:
Paper : 100 marks

Unit I: Basic Circuit Analysis and Simplification Techniques 8L

Voltage and Current laws (KVL/KCL).
Network Analysis: Mesh, Super mesh, Node and Super Node analysis. Source transformation and source shifting.
Network Theorems: Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems, Millers Theorem and its dual.

Unit II: Frequency Selective Networks 7L

Significance of Quality factor.
Series Resonance: Impedance, Phase angle variations with frequency, Voltage and current variation with frequency, Bandwidth, Selectivity. Effect of Rg on BW & Selectivity. Magnification factor.
Parallel resonance: Resonant frequency and admittance variation with frequency, Bandwidth and selectivity. General case: Resistance present in both branches.
Comparison and applications of series and parallel resonant circuits. Twin T and Wein Bridge Networks as Notch Filters.

Unit III: Filters and Attenuators 7L

Classifications: Symmetrical and Asymmetrical networks.
Properties of two port Network:

(i) Symmetrical Networks (T and ∏ only). Z_0 and γ in terms of circuit components, open and short circuit parameters
(ii) Asymmetrical Networks: Image Impedance and Iterative Impedance (L-Section only).

Filters: Filter fundamentals, Constant K-LPF, HPF, BPF and BSF, m derived LPF and HPF, Terminating half sections, Concept of composite filters
Attenuators: Introduction to Neper and Decibel, Relation between Neper and Decibel, Symmetrical T and ∏ type attenuators.

Unit IV: Laplace Transform and Its Applications 6L

Introduction to complex frequency, Definition of Laplace Transform, Basic Properties of Laplace Transform, Inverse Laplace Transform Techniques, Laplace Transform of Basic R, L and C components, Transient response of simple electrical circuits such as RL & RC.

Unit V: Two Port Network Parameters and Functions **7L**

Terminal characteristics of network: Z, Y, h, ABCD Parameters; Reciprocity and Symmetry conditions, Applications of the parameters. Network functions for one port and two port networks, Pole-zeros of network functions and network stability.

Unit VI: Transmission Line Theory **7L**

Types of Transmission lines, Transmission Line Equation, Equivalent circuits, Primary and Secondary line constants, Terminations of transmission lines, VSWR and Reflection Coefficient.

Text Books:

1. D Roy Choudary, "Network and Systems" 1st edition, New Age International, 1988.
2. John D. Ryder, "Network Lines and Fields" 2nd edition, PHI, 1955.
3. C. P. Kuriakose, "Circuit Theory Continuous and Discrete Time System, Elements of Network Synthesis" PHI.

Reference Books:

1. W.H. Hayt Kemmerly, "Engineering Circuit Analysis" , 5th Edition, Tata McGraw Hill Publications, 1993.
2. M.E.VanValkenburg, "Network Analysis", 3rd Edition, Pearson, 2004.
3. Boylestead, "Introductory Circuit Analysis", 4th edition, Charles & Merrill, 1982.
4. Royal Signal Handbook on Line Communication.

204184: Digital Logic Design

Teaching Scheme:	Examination Scheme:
Lectures : 4 hrs/week	Paper :100 M
Practical : 2 hrs/week	Practical : 50 M

Unit I: Combinational Logic Design **6L**

Standard representations for logic functions, k map representation of logic functions (SOP m POS forms), minimization of logical functions for minterms and maxterms (upto 4 variables), don't care conditions, Design Examples: Arithmetic Circuits, BCD - to – 7 segment decoder, Code converters. Quine Mc-Cluskey methods.
Adders and their use as subtractors, look ahead carry, ALU, Digital Comparator, Parity generators/checkers, Static and dynamic hazards for combinational logic.
Multiplexers and their use in combinational logic designs, multiplexer trees, Demultiplexers and their use in combinational logic designs, Decoders , demultiplexer trees.

Unit II: Sequential Logic Design **8L**

1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop ,D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip flops. Conversion of flip flops.
Application of Flip flops: Registers, Shift registers, Counters (ring counters, twisted ring counters), Sequence Generators, ripple counters, up/down counters, synchronous counters, lock out, Clock Skew, Clock jitter. Effect on synchronous designs.

Unit III: Introduction to HDLs **7L**

Library, Entity, Architecture, Modeling styles, Data objects, Concurrent and sequential statements, Design examples, using VHDL for basic combinational and sequential circuits, Attributes (required for practical) (Test benches and FSM excluded).

Unit IV: State Machines **7L**

Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation, Sequence detector. Introduction to algorithmic state machine.

Unit V: Digital Logic Families **7L**

Classification of logic families , Characteristics of digital ICs-Speed of operation , power dissipation, figure of merit, fan in, fan out, current and voltage parameters, noise immunity, operating temperatures and power supply requirements.
TTL-operation of TTL NAND gate, active pull up, wired AND, open collector output, unconnected inputs. Tri-State logic.
CMOS logic – CMOS inverter, NAND,NOR gates, unconnected inputs, wired logic , open drain output.
Interfacing CMOS and TTL.
Comparison table of Characteristics of TTL, CMOS, ECL, RTL, I^2L, DCTL.

Unit VI: Programmable Logic Devices and Semiconductor Memories- 7L

A] Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, Designing combinational circuits using PLDs.
B] Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM, ROM, EPROM, EEPROM, NVRAM, SRAM, DRAM, expanding memory size, Synchronous DRAM (SDRAM), Double Data Rate SDRAM, Synchronous SRAM, DDR and QDR SRAM, Content Addressable Memory.

Text Books:

1. R.P. Jain , "Modern digital electronics" , 3rd edition , 12th reprint TMH Publication, 2007.
2. Stephen Brown, "Fundamentals of digital logic design with VHDL" 1st edition, TMH Publication 2002.

Reference Books

1. Wakerly Pearon, "Digital Design: Principles and Practices", 3rd edition, 4th reprint, Pearon Education, 2004.
2. A. Anand Kumar, "Fundamentals of digital circuits" 1st edition, PHI publication, 2001.
3. Mark Bach, "Complete Digital Design", Tata MCGraw Hill, 2005.

Practical: Digital Logic Design

NOTE: Minimum 09 assignments/ Practical to be covered out of which minimum 4 to be implemented on digital boards, minimum 5 to be Simulated using VHDL code and one study experiment.

Hardware assignments:

1) Design and implement combinational function using MUX and DEMUX ICs.
2) Design and implement single digit BCD adder using binary adder IC.
3) Functional verification of ripple counter IC and synchronous counter IC (MOD-N operation) N should be 2 digits.
4) Functional verification of shift register IC and implementation of pulse train generator using the above IC. Observe the output using logic analyzer.

VHDL assignments (Write VHDL code and simulate)

5) Two bits digital comparator.
6) Four bit ALU for minimum four arithmetic and Logical operations.
7) D f/f and JK f/f (using synchronous and asynchronous reset inputs).
8) Four bits UP/DOWN ripple counter using mode control.
9) Four bit synchronous counters using flip flop.
10) Study of various parameters of logical families and comparative study of TTL and CMOS.

204185: Power Devices and Machines

Teaching scheme: Examination scheme:
Lectures: 4 Hrs/week Paper: 100 Marks

Unit I: Power Diodes and Transistors 8L

Power Diodes: Construction, Switching characteristics, Line frequency diodes.
Power BJT: Construction, Operation, Steady state characteristics, Switching characteristics. Switching limits, Break down voltages, Second breakdown, Thermal runaway.
Power MOSFET: Construction, Operation, Static characteristics, Switching characteristics, Forward and reverse bias Safe Operating Area, Parallel operation.
IGBT: Construction, Operation, Steady state characteristics, Switching characteristics, Safe operating area.
Need for gate / base drive circuits, Isolation techniques, Base drive circuits for- Power BJT. Gate drive circuits for Power MOSFET & IGBT.

Unit II: Thyristors 8L

SCR: Construction, Operation, Transistor analogy, Static characteristics, Switching characteristics. SCR ratings, Gate Characteristics, Triggering requirements, Triggering techniques, Isolation techniques: Pulse triggering, burst triggering, Triggering using ICs.
TRIAC: Construction, Operation, Steady state characteristics, Triggering modes, Principle of DIAC, Phase control using TRIAC.
GTO**:** Construction, Operation, Turn off mechanism, Applications.

Unit III: Power Converters – I 7L

Phase controlled Rectifiers (AC – DC converters): Concept of line & forced commutation Single phase Semi & Full converters for R & R-L loads, Effect of free wheeling diode, Three phase Semi & Full converters for R load.
AC – AC converters: Single phase AC voltage controller for R & R-L loads, Three phase AC voltage controller for R load.

Unit IV: Power Converters – II 7L

DC - DC converters: DC Chopper: - Working principle of step down chopper, control strategies, step down chopper for R-L load, step up chopper**;** SMPS.
DC- AC converters: Inverter: - Working principle of single phase, Bridge inverter for R & R-L load, Three phase bridge inverter for R (star) load, Harmonic reduction , UPS- On line and off line.

Unit V: DC & AC Motors **6L**

Principle of Electromechanical energy conversion, construction of DC motors, Induced emf & torque equations.
Universal Motor: Construction, Working & Characteristics.
Three phase induction motors: Construction, Working & Characteristics.
Introduction to speed control of three phase IM.

Unit VI: Transformers & Special Purpose Motors **6L**

Three phase Transformers: Different connections, constant current & instrument transformers
AC servomotors: Construction, Working & application for encoding.
Stepper Motors: Types, Construction, Working, Characteristics & applications.
BLDC: Construction, Working, Characteristics & applications.
Different protection circuits for motors: over / under voltage / current protection, phase failure, field failure protections.

Text Books:

1. M. D. Singh & K B Khanchandani, "Power Electronics", TMH, New Delhi.
2. Guru, Hiziroglu, "Electric Machinery & Transformer"

Reference Books:

1. M. H. Rashid, "Power Electronics circuits devices and applications", PHI 3rd edition, 2004 edition, New Delhi.
2. P.C. Sen, "Modern Power Electronics", S Chand & Co New Delhi.
3. Ned Mohan, T. Undeland & W. Robbins, "Power Electronics Converters applications and design" 2nd edition, John Willey & sons, Singapore.
4. H. Cotton, "Electrical Technology", CBS.
5. Nagrath Kothari, "Electrical Machines", TMH.

204186 : Network and Power Lab

Teaching Scheme:
Practical: 2 Hrs/week

Examination Scheme:
Term Work: 50 Marks

A. List of experiments for Network Analysis :

1. Network Theorems :
   To verify Thevenin's and Maximum Power Transfer theorem for reactive circuits.
2. Frequency selective networks - I :
   To build and test Series and Parallel resonant circuits.
   (Resonant frequency, Q and Bandwidth, calculations).
3. Frequency selective networks - II :
   To plot the frequency response of Twin T or Wein-bridge circuit.
   (Null frequency calculation)
4. Filter circuits:
   To design build and test constant K- LPF and HPF circuits. Plot the frequency response for both.
5. Attenuators:
   To design, build and test T and ∏ attenuator for given fixed attenuation. Plot attenuation Vs R_L graph
6. Transmission line:
   To measure the primary and secondary line constants of a given transmission line i.e. flat type cable or co-axial cable.

B. List of experiments for Power Lab :

(Any six from the list below - Experiments 6, 7, 8 are compulsory)

1. AC phase control of SCR- Observe load voltage waveform, Measurement of firing angle, average voltage across load, verification of theoretical values with practically measured values.
2. To measure effect of duty cycle on average load voltage for DC chopper using power MOSFET.
3. To study effect of antisaturation circuit on switching time of Power BJT.
4. Single phase Semi converter / Full converter with R load.
5. To find efficiency of given UPS / SMPS.
6. Speed control of DC motor using armature voltage and field control method. Measure RPM and plot graph of speed versus armature voltage and field current.
7. To plot speed-torque characteristic of three phase induction motor.
8. To study drive circuit for stepper motor- phase sequencing and microstepping.

204187: Electronic Instruments and Tools

Teaching Scheme: Examination Scheme:
Practical: 2 Hrs/Week Term Work: 50 Marks

1. Study of Components and Integrated Circuits

Diodes, BJTs, FETs and IC packages (Leaded and surface mount). Their method of soldering.

2. Study of DMM

Measurement of

1. AC voltage mains 230V 2. DC voltage 0-30V
3. AC, DC current 4. Resistance
5. h_{FE} 6. Diode, BJT and FET testing

Understanding errors and frequency limitation in measurement with DMM. Understanding significance of 3-1/2, 4-1/2 digits display and its relation to resolution.

3. Study of Transformers and inductors

Inductors types: Low power, high power (Chokes), Core materials used in inductors and transformers for different frequencies. Transformer Types: Power, Audio, Pulse, RF. Testing Primary & secondary testing & identification.

4. Study of laboratory instruments

Signal generator, Function generator and DC regulated power supplies.

5. Study of Oscilloscopes

Study of various controls on front panel of Dual channel analog and digital oscilloscope with the help of following-

1. Measurement of voltage frequency & time period. Phase measurement using XY mode
2. Storing charging & discharging waveforms of RC circuits using DSO. Measure rise & fall times.
3. Store signals at different trace locations & retrieve it.
4. Find out propagation delay of a logic gate.
5. Connect function generator output to DSO & observe different waveform at different frequency.

6. Study of frequency counter

Measurement of frequency, time period, frequency ratio & external counter (Totalizer)

1. Connect frequency generator to frequency counter. Set frequency of generator to 100Hz, 1kHz, 10kHz, 100kHz, MHz & measure frequency & time period.
2. Connect two frequency sources A & B to frequency counter & measure ratio of them.
3. Check function of timer & counter using start & stop control of frequency counter.

7. PCB designing

1. Study of types of PCBs: Single sided, Double sided, Multilayer, Flexible
2. General PCB design considerations.
3. Soldering and de-soldering practice on general purpose PCB
4. Breadboard wiring- Build and test given circuit on breadboard.

Note:

1. Tool kit should consist of following items
   a. Soldering Gun
   b. Cutter
   c. Nose pliers
   d. De-soldering strip/pump
2. Group of 3-students should have their own tool kit with them.
3. Journal should contain write-ups prepared by students by referring to various web sites and reference books, specifications of instruments, datasheet of components.

Reference Books:

1. Walter C. Bosschart, "Printed Circuit Boards Design & Technology" , TMH.
2. RS catalogue for components
3. Dr. Madhuri A. Joshi, "Electronic Components & Materials", Shroff publishers & distributors
4. Operation Manuals of Instruments
5. Paul Horowitz, "The Art of Electronics" , Winfield Hall, Cambridge

207003: ENGINEERING MATHEMATICS III

Theory Teaching: 04 hours per week
Tutorial: 01 hour. per week

Theory Exam: 100 marks, 03 hrs duration
Term Work: 25 marks

SECTION I

Unit I: Linear Differential Equations (**LDE**) (09 Hours)
Solution of n^{th} order LDE with Constant Coefficients, Method of Variation of Parameters, Cauchy's & Legendre's DE, Solution of Simultaneous & Symmetric Simultaneous DE, Modeling of Electrical Circuits.

Unit II: Complex Variables (09 Hours)
Functions of Complex Variables, Analytic Functions, C-R Equations, Conformal Mapping, Bilinear Transformation, Cauchy's Theorem, Cauchy's Integral Formula, Laurent's Series, Residue Theorem.

Unit III: Transforms (09 Hours)
Fourier Transform (FT): Complex Exponential Form of Fourier Series, Fourier Integral Theorem, Sine & Cosine Integrals, Fourier Transform, Fourier Sine and Cosine Transform and their Inverses, Application to Wave Equation.
Introductory Z-Transform (ZT): Definition, Standard Properties, ZT of Standard Sequences and their Inverses. Solution of Simple Difference Equations

SECTION II

Unit IV: Numerical Methods (09 Hours)
Interpolation: Finite Differences, Newton's and Lagrange's Interpolation formulae, Numerical Differentiation.
Numerical Integration: Trapezoidal and Simpson's Rules, Bound of Truncation Error,
Solution of Ordinary Differential Equations: Euler's, Modified Euler's, Runge-Kutta 4^{th} Order Methods

Unit V: Vector Differential Calculus (09 Hours)
Physical Interpretation of Vector Differentiation, Vector Differential Operator, Gradient, Divergence and Curl, Directional Derivative, Solenoidal, Irrotational and Conservative Fields, Scalar Potential, Vector Identities

Unit VI: Vector Integral Calculus (09 Hours)
Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence Theorem, Stoke's Theorem, Applications to Problems in Electro-Magnetic Fields

Text Books:

1. Advanced Engineering Mathematics by Peter V. O'Neil (Cengage Learning).
2. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.).

Reference Books:

1. Engineering Mathematics by B.V. Raman (Tata McGraw-Hill).
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics, Wylie C.R. & Barrett L.C. (McGraw-Hill, Inc.)
4. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).
5. Applied Mathematics (Volumes I and II) by P. N. Wartikar & J. N. Wartikar (Pune Vidyarthi Griha Prakashan, Pune).
6. Advanced Engineering Mathematics with MATLAB, 2e, by Thomas L. Harman, James Dabney and Norman Richert (Brooks/Cole, Thomson Learning).

204188: Integrated Circuits and Applications

Teaching Scheme:
Lectures: 4 Hrs/Week
Practical: 2 Hrs/Week

Examination Scheme:
Paper: 100 Marks
Practical: 50 Marks

Unit I: Operational Amplifiers Building Blocks **6L**

Block diagram of Op Amp, Differential amplifier and its analysis, Level shifter, Output stages, Current sources and current mirror circuits. Ideal and practical Op Amp comparison. Op Amp technologies and comparison- Bipolar, CMOS and BiCMOS. Ideal Op Amp analysis, DC and AC characteristics.

Unit II: Op Amp Performance Parameters **6L**

Op Amp powering. Op Amp input and output limitations**,** limitations in gain, input and output impedance, practical Op Amp frequency response characteristics, small signal closed loop frequency response, closed loop stability considerations, frequency compensation, transient response characteristics, full power response, offsets, bias currents and drift. Common Mode Rejection Ratio of Op Amp, noise in Op Amp.

Unit III: Applications of Op Amps- I **6L**

Voltage scaling and buffer circuits, Voltage summation, Difference amplifier configuration, current scaling, voltage to current conversion, AC amplifiers.
Amplifiers with defined non-linearity, synthesized non-linear response, Basic integrator, Integrator run, set and hold modes, integrator errors, extensions to basic integrator, integrator reset, AC integrators, Differentiator, practical considerations in differentiator design.

Unit IV: Applications of Op Amps- II **6L**

Limitations of difference amplifiers, Instrumentation amplifiers and applications, Introduction to isolation amplifiers. Op Amp comparators, Schmitt Trigger, Op Amp for square, triangular and pulse generation, zero crossing detector, Precision rectifiers, Peak detector, Sample and hold circuits. Linear voltage regulators, Low dropout regulators. Limitations of linear regulators.

Unit V: Signal Converters **6L**

Voltage to frequency conversion, frequency to voltage conversion. Digital to Analog converter operation, specifications interfacing and applications: DA converter operation and specifications, DA applications and interfacing.
Analog to Digital converter specifications, types and interfacing: Parallel comparator, Dual slope, Successive approximation, Sigma-delta. Specifications and error associated with AD converters. Interfacing AD converters.

Unit VI : Active Filters And Phased Locked Loop **6L**

Op Amp bases audio amplifier circuits- Preamplifier, Active tone control, Graphic equalizer. First and second order active LPF, HPF, BPF and Notch filters. Phased lock loop, lock and capture, PLL in locked condition, first order loop, second order loop, damping characteristics, and filter design criteria. Phase comparators. FM demodulator, frequency synthesizer.

Text Books

1. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, Tata McGraw hill Ltd.
2. George Clayton, "Steve Winder, Operational Amplifiers", 4th Edition, Newnes.

Reference Books

1. Ramakant A. Gaikwad, "Op Amps and Linear Integrated Circuits" , 4th Edition, Pearson Education.
2. S. Salivahanan, V S Kanchanabhaskaran, "Linear Integrated Circuits", 1st edition, Tata McGraw-Hill.
3. Sedra Smith, "Microelectronic Circuits", 5th Edition, Oxford.
4. Doughlas V Hall, "Microrpocessors and Interfacing", 2nd Edition, McGraw-Hill

List of Practical

1. To plot DC transfer characteristic of differential amplifier.
2. To study effect of offset voltage on output of preamplifier using general purpose Op Amp and precision Op Amp.
3. To design and test Op Amp integrator for given frequencies
4. To design, build and test Schmitt trigger and plot transfer characteristic.
5. To design, build and test RTD based bridge circuit and interface with instrumentation amplifier.
6. To design, build and test V-I converter for given specifications. Grounded and floating load.
7. To design, build and test half wave and full wave precision rectifier circuits for given specifications.
8. Design, build and test Op Amp based Wein Bridge oscillator for given frequency.

204189: Electromagnetics

Teaching Scheme:
Lectures: 4 hrs/week
Tutorial: 1 hr /week

Examination scheme:
Paper: 100 Marks
Term work: 25 Marks

Unit I: Basic Electrostatics **6L**

Coulomb's Law & Field Intensity, Electric Field due to continuous charge distributions,
Electric Flux Density, Gauss's Law, Applications of Gauss's law: some symmetric charge distributions and differential volume element, divergence, divergence theorem.

Unit II: Applied Electrostatics **6L**

Electric potential, Relationship between E & V, Potential Gradient, Electric Dipole and Flux Lines, Energy density in electrostatic field, Current and current Density, continuity equation, Laplacian & poissions equation, capacitance, capacitance of parallel plate capacitors including two wire capacitors with multiple di-electrics, derivations of Poisson's and Laplace's equations & applications.

Unit III: Magnetostatics and Applications **6L**

Biot-Savart's Law, Ampere's Circuital Law, Applications of Ampere's law, magnetic flux density, Magnetic Scalar and vectors potentials, Derivations of Biot-savarts law and Ampere's law based on Magnetic Potential, Forces due to magnetic field, magnetic dipole.

Unit IV: Boundary Conditions and Analysis **6L**

Conductors, dielectrics, polarization in dielectrics, dielectric constants and strength, Boundary conditions with free space, Conducting and dielectric medium for electrostatic and magnetostatic fields.

Unit V: Time Varying Fields and Maxwell's equations **6L**

Faraday's law, Displacement current, Maxwell's equations in point form and integral form, Power and Poynting theorem, Time varying potential, Time harmonic field, Concept of Uniform Plane Wave.

Unit VI: Numerical Electromagnetics and Applications **6L**

Tutorials

1) Application of Stoke's theorem.
2) Application of Gauss's law.
3) a) Energy stored in capacitor.
   b)Application of Poission's and Laplace's equations.
4) Applications of Ampere's law
5) a) Boundary conditions for electrostatic fields.
   b) Boundary conditions for magnetic fields.
6) Power, Poynting theorem and their applications.

Text Books:

1. Hayt & Buck, Engineering Electromagnetics, 7th Edition, Tata McGraw-Hill.
2. Matthew Sadiku, Elements of Electromagnetics, 3rd Edition, Oxford University Press.

Reference Books:

1. Edminister J.A, Electromagnetics, Tata McGraw-Hill.
2. R.K Shevgaonkar, Electromagnetic waves,Tata McGraw-Hill.
3. K.B Madhu Sahu, Electromagnetic Fields, 2nd Edition, SciTech.
4. N. N. Rao, Elements of Engineering Electromagnetics, 6th Edition. Pearson Education.

204190: Data Structures

Teaching Scheme:
Lectures : 4 hrs/week

Examination Scheme:
Paper : 100 marks

Practical: 2 hrs/week

Practical: 50 marks

Unit I: Arrays & Functions in C **6L**

Algorithm: How to create program, How to analyze program , Arrays: Single dimensional & Two dimensional; Searching Methods: Sequential Search, Binary Search; Sorting Methods: Selection sort, Bubble sort, Insertion sort. Analysis & comparison of above algorithms, Abstract Data Type and ADT of arrays, Functions: Passing parameter by value, recursive functions.

Unit II: Pointers & Structures in C **6L**

Pointers: Basic concept, Arrays & Pointers (Static and dynamic allocation), Functions & Pointers (Passing by reference) , Strings: Basic concepts , Structures in C , Array of structures, passing structure to function, structures and pointers, Unions, Bitwise Operators, Concept of ordered list & polynomial representation using array of structures.

Unit III: Data Structure Using Linked Organization **8L**

Concepts and definition of data, data type, data object, data structures and abstract data structure (ADT), realization of ADT in C - array as an ADT. Concept of Singly Linked List, Doubly Linked List, Insertion, deletion and traversals of above data structure ,Representation and implementation of polynomial using SLL, Concept of Circular Linked List. Applications of Linked lists. Generalized linked list: Representation of polynomial using GLL.

Unit IV: Stacks and Queues **8L**

Stacks: Definition & example, representation using arrays & linked list. Applications of stack, Concept of infix, postfix and prefix expressions, conversion of infix to postfix expression, evaluation of postfix expression and removal of recursion, Queues: Definition & example, representation of queue using array and linked list, circular queue, concept of priority queue, applications of Queue.

Unit V: Trees **8L**

Difference in linear and non-linear data structure, Basic terminology, Binary trees, binary search tree representation, BST traversals, Primitive operations on BST: Create, insert, delete.
Binary Trees: Create insert and traversals operations. Threaded Binary trees: primitive operations, Non-recursive pre-order and in-order traversals. [implementation not expected]. Concept AVL trees and examples. [implementation not expected]

Unit VI: Graphs **6L**

Concepts and terminology, Types of graphs—directed graph, undirected graph, planar graph, representation of graph using adjacency matrix, adjacency list, Traversal, DFS & BFS. Shortest path algorithm: Dijkstra's algorithm, Minimal spanning tree: Kruskal, Prim's algorithm.

Text Books:

1. Yedidyah Langsam, Moshe J Augenstein, Aaron M Tenenbaum - Data structures using C and C++ - PHI Publications (2nd Edition).
2. Ellis Horowitz, Sataraj Sahni- Fundamentals of Data Structures - Galgotia Books source.

Reference books:

1. E Balgurusamy - Programming in ANSI C, Tata McGraw-Hill (Third Edition)

List of Practical

1) Searching methods-Linear & Binary
2) Sorting Methods-Bubble, Selection & Insertion.
3) Data base Management using array of structure.
4) Polynomial addition using array of structure.
5) Implementation of singly linked list- Create, Insert, Delete, Search.
6) Implementation of stack using arrays & LL.
7) Queue using array & LL.
8) Evaluation of postfix expression (input will be postfix expression)
9) Operations on Binary search tree: Create, search, recursive traversals.
10) Implementation of Graph using adjacency Matrix.

List of Programs Optional For Students To Strengthen the Knowledge of the Subject. These Programs will not be part of the practical exam/journal:

1) Multiplication of two matrices.
2) Program on passing parameters to function by value and by reference.
3) Implementation of Recursive function for finding n !
4) Searching in a list of names.
5) Sorting list of names.
6) Conversion of Decimal Number into Binary using Bitwise Operaters.
7) Addition and multiplication of Polynomials using Linked List.
7) Implementation & Operations on Doubly Linked List
8) Convert an infix expression into postfix.
9) Non recursive inorder traversal.

204191: Communication Theory

Teaching Scheme:	Examination Scheme:
Lectures: 03 Hrs/week	Paper: 100 Marks
Practical: - 02 Hrs/week	Oral: 50 Marks

Unit I: Amplitude (Linear) Modulation **6L**

Base band & Carrier communication, Generation of AM (DSBFC) and its spectrum, Power relations applied to sinusoidal signals, DSBSC – multiplier modulator, Non linear generation, switching modulator, Ring modulator & its spectrum, Modulation Index. SSBSC, ISB & VSB, their generation methods & Comparison, AM Broadcast technical standards.

Unit II: Angle Modulation **6L**

Instantaneous frequency, Concept of Angle modulation, frequency spectrum, Narrow band & wide band FM, Modulation index, Bandwidth, Phase Modulation, Bessel's Function and its mathematical analysis, Generation of FM (Direct & Indirect Method), Comparison of FM and PM.

Unit III: AM and FM Receivers **6L**

Block diagram of AM and FM Receivers, Super heterodyne Receiver, Performance characteristics: Sensitivity, Selectivity, Fidelity, Image Frequency Rejection, IFRR. Tracking, De-emphasis, Mixers.
AM Detection: Rectifier detection, Envelope detection,
Demodulation of DSBSC: Synchronous detection,
Demodulation of SSBSC: Envelop detector
FM Detection using PLL.

Unit IV: Noise **5L**

Sources of Noise, Types of Noise, White Noise, Thermal noise, shot noise, partition noise, Low frequency or flicker noise, burst noise, avalanche noise, Signal to Noise Ratio, SNR of tandem connection, Noise Figure, Noise Temperature, Friss formula for Noise Figure, Noise Bandwidth.

Unit V: Behavior of Analog Systems in Presence of Noise **6L**

Base band systems, Amplitude modulated systems- DSBSC, SSBSC & AM, Angle modulated systems- phase modulation, frequency modulation, Threshold in angle modulation, Pre emphasis & De emphasis in FM, Comparison of performance of AM & FM systems.

Unit VI: Digital Transmission of Analog Signals **7L**

Band limited & time limited signals, Narrowband signals and systems, Sampling theorem in time domain, Nyquist criteria, Types of sampling- ideal, natural, flat top, Aliasing & Aperture effect. Pulse Analog modulation: PAM PWM & PPM.
PCM – Generation & reconstruction, Bandwidth requirement of PCM.
Differential PCM, Delta Modulation & Adaptive DM. ((Only Block diagram treatment).

Text Books:

1. B. P. Lathi : Modern Digital and Analog. Communication Systems : Oxford Press Publication (Third Edition)
2. Dennis Roddy & Coolen - Electronic Communication, PHI (Fourth Edition)

Reference Books:

1. Simon Haykin: Communication Systems, John Wiley & Sons (Fourth Edition)
2. Taub & Schilling: Principles of Communication Systems, Tata McGraw-Hill
3. Leon W.Couch, II: Digital and Analog Communication Systems, Pearson Education (Seventh Edition)

List of Practical:

1. Class C Single Tuned amplifier.
2. a) AM Generation (DSB-FC): Calculation of modulation index by graphical method, Power of AM Wave for different modulating signal.
   b) Envelope Detector - Practical diode detector, Observe effect of change in RC time constant which leads to diagonal and negative clipping
3. AM transmitter: Measure Total power of transmitter with the help of Spectrum Analyzer or Wattmeter, Observe variation in total power by varying modulating signal level
4. a) Frequency modulator using varactor diode and NE 566 VCO, calculation of modulation index
   b)FM demodulator using IC 565 (PLL based)
5. Study of FM Transmitter; observe output waveform using Spectrum Analyzer and see the effect of Eigen values on carrier power.
6. Measurement of Receiver Characteristics: Sensitivity, Selectivity, Fidelity.
7. Generation of DSB-SC with the help of Balanced Modulator IC1496/1596 & its detection
8. SSB modulator using Filter method, phase shift method & its detection
9. Build & test AM / FM Transmitter. (Mandatory)
10. Verification of Sampling Theorem, PAM Techniques, (Flat top & Natural sampling), Effect of variable sampling rate, filter cutoff, reconstruction of original signal using Interpolation Filter. Aliasing Effect in frequency domain.

Note: Transmitter and Receiver experiments shall mandatory be carried out at Radio Frequency (preferably above 500 KHz).

204192: Circuit Simulation and Tools

Teaching Scheme: Examination scheme:
Practical: 2 hours/ week Term Work: 50 marks

Following assignments should be performed in MATLAB or OCTAVE:

1. Generate any four waveforms out of the following
2. Periodic waveforms such as sine wave, square wave, triangular wave. Non-periodic waveforms such as ramp, step, impulse, exponential (rising and decaying).
3. Find output of a LTI system to a given input from its impulse response. (Hint: use convolution). Find first 50 samples of step response of a LTI system.
4. Compute auto-correlation and cross correlation two sequences.
5. Find frequency response of a LTI system from given impulse response.
6. Generate a square wave of given frequency from fundamental frequency and its harmonics. (Apply concept of Fourier series).

C program assignments:

1. Write a C program to compute convolution of two sequences.
2. Write a C program to compute auto-correlation of a signal. Comment on the results.
3. Write a C program to compute cross-correlation of the signal. Compare the steps involved in convolution operation and correlation operation and identify the difference between these two operations.

Network Analysis assignments:

Following assignments should be performed in MATLAB or OCTAVE

1. To plot frequency response of frequency selective network (Twin T or Wein bridge)
2. Plot resonance curves for series and parallel resonance circuits for given values of R, L and C. Find resonance frequency, bandwidth and Q for given values of L, C and R.
3. Plot pole zero map and frequency response of a filter for given order (LPF, HPF, BPF and BSF)

Communication Theory assignments:

a) Following assignments should be performed in MATLAB or OCTAVE

1. Generate AM waveform for given modulation index, signal frequency and carrier frequency.
2. Generate FM waveform for given signal amplitude and carrier frequency.
3. Prove sampling Theorem. Reconstruct the analog signal from its samples. Observe aliasing effect by varying sampling frequency.
4. Observe the effect of variation of relevant parameters of the distribution function on the shape of following functions.
5. Normal Distribution, Poisson distribution, Binomial Distribution, Rayleigh Distribution, Beta Distribution, Gamma Distribution, Geometric Distribution, Discrete uniform Distribution, Uniform Continuous Distribution, Exponential Distribution, Hyper geometric Distribution.

b) Generate noise corrupted in Simulink and pass it through the matched filter block.
Observe the output of the filter. It should be clean noise free signal.