EE 645: ANALOG ELECTRONICS – II

L T P (3 1 3)
Full marks: Theory = 100
Sessional = 50
Lab = 50

CHAPTER – 1 INTRODUCTION TO OPERATIONAL AMPLIFIERS:

Dual Input-Balanced Output Differential Amplifier using BJT, DC Analysis, AC Analysis, CMRR. Analysis of Single Input and Unbalanced Output Differential Amplifier. FET Differential Amplifier. Cascade of Differential Amplifier Stages. Block Diagram of a typical OPAMP. Pin Layout of a typical OPAMP IC. Characteristics of an ideal OPAMP. Practical OPAMP – Error due to Offset Voltage and Offset Current, Input Bias current, Offset Nulling in a typical OPAMP IC. Frequency Response of OPAMP. Effect of Noise and Nulling of Noise. Open Loop Application of OPAMP.

CHAPTER – 2 GENERAL LINEAR APPLICATIONS OF OPAMP

Non-Inverting Amplifier, Inverting Amplifier, Differential Amplifier, DC Amplifier, AC Amplifier, Peaking Amplifier, Summing Amplifier, Scaling Amplifier, Averaging Amplifier, Instrumentation Amplifier, Differential Input-Differential Output Amplifier, Voltage-to-Current Converter, Current-to-Voltage Converter, Integrating Amplifier, Differentiating Amplifier, Log Amplifier, Antilog Amplifier, Multiplier and Divider, Analog Simulation of Differential Equations (Analog Computer)

CHAPTER – 3 NON-LINEAR APPLICATIONS OF OPAMP

Comparator. Zero Crossing Detector. Schmitt Trigger. Astable Multivibrator. Monostable Multivibrator. Triangular Wave Generator. Sine Wave Generator. RC Oscillators, Phase Shift Oscillator, Wien Bridge Oscillator, Quadrature Oscillator. Voltage Controlled Oscillator. Voltage-to-Frequency Converter. Frequency-to-Voltage Converter. Clipper. Clamper. Peak Detector. Absolute Value Output Circuit. Sample-and-Hold Circuit. Ladder network in DAC application. Various type of ADC (for example - Up-counter, down-counter, dual slope ADC etc)

CHAPTER – 4 OPAMP BASED SPECIAL PURPOSE IC's

Monolithic Power Amplifier IC. Transconductance Amplifier IC-. Analog-to-Digital Converter IC. Digital-to-Analog Converter IC. Voltage Regulator IC.s - 78XX Series IC.s, 723 Voltage Regulator. Switched Mode Power Supply (SMPS). 555 Timer IC- Functional Block Diagram, Application as Monostable Multivibrator, Astable Multivibrator and Schmitt Trigger. PLL – Basic Principles, General Description and Application the 565 PLL IC.

CHAPTER – 5 ACTIVE FILTERS USING OPAMP

Classification of filters. Order of filters. Analysis and Design of Butterworth Filters using OPAMP, First Order Low Pass Butterworth Filter, Second Order Low Pass Butterworth Filter, First Order High Pass Butterworth Filter, Second Order High Pass Butterworth Filter, Band Pass Filter, Band Stop Filter, All Pass Filter. State Variable Filter. Switched Capacitor Filter.

REFERENCE BOOKS:

EE 644: Electric Power System-II.

L T P
(3 1 0)
Max. Marks = 100
Sessional = 50

1. **Substations:**

Classification. Interconnection of substations, Necessity. Function & arrangement of substation equipment. Layout diagram- single line diagram with different bus-bar arrangements. Current limiting reactors: Types and construction, substation grounding.

2. **Neutral grounding:**

Effectively grounded system. Under grounded system. Arching ground. Methods of neutral grounding. Resonant grounding (Peterson coil). Earthing transformer. Generator neutral breaker. Grounding practice as per Indian electricity rules. Equipment grounding.

3. **Circuit breakers:**

Fuses: Function: Important terms & classification. HRC fuses: Characteristics & advantages. Time delay fuse.

Switchgears: Functions, principles of circuit breaking. DC & AC circuit breaking. Arc voltage & current waveforms. Restriking & recovery voltages, Current zero pause. Current chopping, capacitive current breaking. AC circuit breaker ratings. Arc in oil, arc irruption theories and processes. Bulk oil CB & MOCB, air circuit breaker, air –blast CBs. Vacuum & SF_6 CBs. Testing of circuit breakers.

4. **Protective relays:**

operating principles; Terminology & functional characteristics of Protective relays. Universal relay torque equation. Over current relays. Differential relays. Feeder, generator & transformer protection. Distance relays. Reverse, Translay relays, carrier current protection, comparators. Static relays: operating principles, advantages, types. Example with block diagram and circuit diagrams and operational principle.

5. **Over-Voltage Phenomena in Power Systems:**

Lightning phenomena, Switching surges, Travelling Waves, Shape and Specification of Travelling waves, Attenuation and distortion of traveling waves, attenuation due to corona, behaviour of traveling waves at a line transition, Construction of Bewely lattice diagram.

6. **Over voltage protection & Insulation co-ordination:**

Surge protection. Different types of lightening arresters & surge absorbers. Ground & counterpoise wires. Location & rating of lightening arresters. Introduction to Insulation co-ordination. Volt-time curve. Important terms. BIL & factors affecting it.,co-ordination of system equipment.

7. **HVDC transmission and Systems of Electric Power Transmission:**

Limitations of HVAC transmission. Advantages & limitations of HVDC transmission. Kinds of DC links. Ground return. Equipment for HVDC transmission. Economic distance. Application of HVDC systems.

Review of Existing Systems, Advantages and Limitations of using high transmission voltages, Comparison of overhead and underground systems, Economic voltage of transmission, Economic size of conductors, Kelvin's law

REFERENCES:

1. Electrical Power—S.L.Uppal.
2. Electrical Power System---C.L.Wadha.
3. Electrical Power System's design—M.V. Despande.
4. Switchgear principles—P.H.J.Crane.
5. Switchgear and Protection—S.S. Rao
6. Switchgear and Protection-- M.V. Despande.

1. OPAMPS And Linear Integrated Circuits : by : R.A. Gayakwad : PHI
2. Linear Integrated Circuits : by : Roy Choudhury & Jain : Wiley Eastern
3. Microelectronics : by : Jacob Millman : TMH

EE643: Microprocessors/Microcontrollers and Applications (EE/IE)

L T P (3 1 3)
Full marks: Theory = 100
Sessional = 50
Lab = 50

1. Microprocessor Architecture:

Introduction to the microprocessor- Introduction to tri-state device- register, ALU, counter etc. Basic concepts of programmable device – Bus organization, system components etc. Block diagram of μP 0885- data bus, address bus, timing and control section, registers, etc.

2. Interfacing memory devices and I/O devices-

Address space and its portioning, address decoding, memory and I/O mapping and management.

3. Programming Microprocessors:

Data representation, instruction formats, addressing modes, Instruction set, software design, assembly language programming, program looping, subroutine linkage - uses of stack and stack pointer, push pop operation etc. Assembly and code language programming with examples, timing diagram of instructions.

4. Support PPIs:

PPIs - 8255, 8253 and 8279; their functional block diagram, operational modes and configuration of the device in different mode of operations, assembly language program for using the PPIs in application purposes. Such as, data transfer, counter operation and display data in seven segment LED display units and data to read data through key board respectively.

5. Application of μP based system : Microprocessor based instrumentation system for measurement of physical parameters, such as - temperature, light intensity, smoke, moisture content etc. Operation electro-magnetic and static relay for switching operation. A traffic light control, speed controller of de motor etc.

Books:

1. Microprocessor architecture, programming and applications—Ramesh S Gaonakar –Penram International
2. Fundementals of Microprocessors and Microcontrollers—B Ram—Dhanpat Rai Publications
3. The 8085 Microprocessor and Programming and Interfacing—K Udantkus—Pearson Education

EE 641: Optimization Techniques in Engineering

L T P
(3 1 0)
Full marks: Theory =100
Sessional =50
Time=3 hours

1. Introduction:

Introduction to optimization, Engineering Applications of optimization, Formulation of problems as mathematical programming problems, classification of optimization problems

2. Classical Optimization Techniques:

Single variable optimization, Multivariable optimization without constraints: necessary and sufficient conditions, the Newton-Raphson method; Multivariable optimization with equality constraints: Jacobian method and Lagrange's multiplier method; Multivariable optimization with inequality constraints: Kuhn Tucker conditions.

3. Linear Programming:

Formulation of LPP, Graphical and simplex method of solution of LP problems, Duality in LP, Sensitivity analysis

4. Non-linear Programming:

Unconstrained algorithms: Direct search and Gradient methods; Constrained algorithms: Separable programming, Quadratic programming

5. Dynamic Programming:

Multi-stage decision process, Structure and characteristics of dynamic programming, principles of optimality, deterministic dynamic programming

Books:

1. Engineering Optimization Theory & Applications, S.S. Rao, New Age International Pvt. Ltd.
2. Optimization Concepts and Applications in Engineering-A.D. Belegundu, T.R. Chandrupatia, Perason Education, Asia
3. Operations research- An Introduction-H.A. Taha,Eastern

EE 642: POWER ELECTRONICS (EE / IE)

L T P
3 1 3
Theory Marks= 100
Sessional Marks=50
Lab=50

1. **Semiconductor Power Devices:**

Introduction, power diodes, power transistors (BJT, MOFET, IGBT, ICT etc) and SCRs and their operations, GTOs, Triacs and other types of thyristors, their characteristics, ratings, mounting and cooling. Series and parallel connections of SCRs. Triggering and control.

2. **Regulated Power supplies**:

Requirements and principles Constant voltage and current regulators, use of ICs,
Line regulation, introduction to switching regulators. Switching mode power supply, UPS – ON-line and OFF-LINE types,

3. **Converter Operation with SCRs:**

Single phase half- wave, full- wave and bridge circuits, three- phase half wave and bridge circuits, six- phase with interphase transformer, fully controlled and half- controlled circuits. Effects of load and source inductance. AC controller – single phase and three phase, half control and full control, applications of ac controllers. Dual converter and cycloconverter operating modes. Line commuted inverters, firing and control circuits for different operations.

4. **Forward commutation and Forced Commutated inverters:**

Forced commutation circuits, parallel, series and bridge (single- phase and three- phase) inverters, McMurray and McMurray- Bedford inverter circuits, Voltage and current source inverters. Output voltage control harmonics eliminations. Firing circuits for inverters.

4. **Choppers:**

Principles of operation, classification, Time Ratio control & Current Limit Control, DC, AC, and multi-quadrant choppers, Heumann's (voltage commutated), Morgan's, Jone's, and Mazda's choppers. Applications.

5. **Applications of SCRs**:

SCR battery chargers, replacement of electromechanical devices by SCRs.

References:

1. Gray, P.E.&c.L.Scurle: Electronic Principles- Wiley Eastern.
2. Grabane, A.B.:Analog integrated Circuit Degign- Van Nortrand.
3. Ramamoorthy, m.: An Introduction to Thyristors and their Applications- East West Press.
4. Rashid, M.H. Power Electronics, Circuits, Devices and Applications- Prentice Hall of India.
5. Sen, P.C.: Power Electronics- TMH.
6. Dubey et al; Thyristorised Power Controllers- Wiley Eastern..

EE 646: SIGNALS AND SYSTEMS

L	T	P
3	1	0

Maximum marks: 100
Sessional 50

1. **Introduction**: Definitions, continuous-time (CT) and discrete-time (DT) signals, exponential and sinusoidal signals, signal energy and power, even and odd signals, periodic signals, transformation of independent variables: time-shift, time-reversal and time-scaling, CT and DT systems and their classification, basic properties of CT and DT systems. (6hrs)

2. **LTI Systems**: DT LTI systems: convolution sum, CT LTI systems: convolution integral, properties of LTI systems: commutative, distributive and associative properties, LTI systems with and without memory, invertibility, causality and stability of LTI systems, systems described by differential and difference equations. (7hrs)

3. **Fourier series analysis for CT and DT signals**: Response of LTI systems to complex exponential, representation of periodic signals: the Fourier series, properties of Fourier series, convergence of Fourier series. (5hrs)

4. **Fourier transform analysis for CT and DT signals**: Representation of a-periodic signals: the Fourier Transform, properties of Fourier transform, System analysis by Fourier Transforms, convergence of Fourier transform. (5hrs)

5. **Sampling**: Sampling theorem, effect of under-sampling, reconstruction of a signal from its samples using interpolation, Spectrum of sampled signal. (5hrs)

6. **Z-transform**: Definitions, region of convergence, properties of Z-transform, inversion of Z-transforms, system function, applications to system analysis. (6hrs)

7. **Digital Filters**: Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) systems, FIR and IIR filters, realization of FIR and IIR systems. (6hrs)

Books:

1. Oppenheim, A.V.,Willsky, A.S., Nawab,S. H.: Signals and Systems, Prentice Hall India
2. Proakis, J.G.& Manolikis, D.G.: Digital Signal Processing-principles, algorithms and applications, Prentice Hall India
3. Robert, M. J.: Signals and Systems, Tata McGraw Hill
4. Rawat, T.K.: Signals and Systems, Oxford University Press
5. Mitra, S.K.: Digital Signal Processing-a computer based approach, Tata McGraw Hill
6. Xavier, E: Signals, Systems & Signal Processing, S. Chand & Co.
7. Mastering MATLAB, Pearson Education (for Laboratory use).