L T P
(3-1-3)
Full marks: Theory—100
Sessional---------50
Lab--------50
Time---3 hrs

EE 642: Computer Oriented Numerical Methods:

1. Computer Arithmetic:

Introduction, Floating point representation of numbers and floating point arithmetic, computational errors, Relative and absolute errors, Error propagation, Iterative processes-convergence and acceleration.

2. Iterative methods:

Transcendental equations, Methods of bisection, Method of false position, Newton Raphson method, Complex roots, Synthetic division.

3. Matrices and Linear Systems of Equations:

Matrix inversion, LU decomposition, Solution of linear system of equations by direct methods—Gauss elimination method, ill—conditioned system, Pivotal condensation, Gauss-Siedel iteration method, Gauss-Jordan matrix inversion, Eigen values and Eigen vectors, N—R method for non-linear system of equations.

4. Finite Difference and Interpolation:

Forward difference, Backward difference and central difference, Symbolic relations, Interpolation with equal intervals, Interpolation using forward difference, Newton's and Gauss's formula for interpolation, Interpolation with unequal intervals, Newton's formula, Lagrange's polynomial interpolation.

5. Numerical Differentiation and Integration:

Differentiation by polynomial fit, errors in numerical differentiation, numerical integration—Trapezoidal rule, Simpson's rule, Romberg method.

6. Ordinary Differential Equations:

Taylor's series method, Euler's method, Modified Euler's method, Runga-Kutta method, Predictor-Corrector method.

**Note: Stress should be given on developing algorithms for the numerical methods. Sessional and laboratory work should consist of writing computer programs using these algorithms and running them on the computer.

L T P

EE 645: CONTROL SYSTEM- II.

(3 1 3)
Theory marks = 100
Sessional= 100
Time----- 3 hours.

1. **Compensation techniques**:

Preliminary design specifications in time and frequency domains, gain compensation; load compensation, lag compensation, leg- load compensation.

2. **Describing function analysis of non linear control systems:**

Introduction to nonlinear systems. Describing functions of common non linearities; nonlinear control systems, describing function analysis of nonlinear control systems.

3. **Phase- Plane Analysis:**

Introduction, methods of constructing phase- plane trajectories, time information and solutions from phase- plane trajectories, singular points, phase- plane analysis of linear and nonlinear control systems.

4. **Discrete time systems**:

Introduction to discrete – time systems; Z- transform, inverse Z- transformation; solving difference equation by the Z-transform method; pulse- transfer function; stability analysis in the Z- plane.

5. **State – Space Analysis of control systems:**

Concepts of space, state variables and state models; state – space representation of linear systems; transfer matrix; state- space representation of discrete- time systems. Solution of linear time- invariant and discrete- time state equations.

6. **Stability Analysis by Liapunov's second method**:

Definition of stability in the sense of Liapunov; the second method of Liapunov; Stability analysis of linear systems; estimating the transient response behaviour of dynamic systems; stability analysis of nonlinear systems.

7. **Design of Feedback Control systems**:

Concept of controllability and observality; state feedback and output feedback; a brief idea of pole placement by state feedback and output feedback; optimal control law; cost function or performance index; quadratic performance index; linear quadratic state feedback regulator problem; a brief introduction to model reference systems; adaptive control systems.

EE 641: Electromagnetic Fields (EE)

L T P
(3 – 1 – 0)
Theory Marks =100
Sessional Marks = 50
Time = 3 hours

1. **Vector Analysis:**

Review of dot and cross products, gradient, divergence and curl. Divergence and Stock's theorem, Cartesian, Cylindrical and Spherical co-ordinates system. Transformation between co-ordinates, General curvilinear co-ordinates. Value of gradient divergence and curl in general co-ordinates and to obtain there from their values in cylindrical and spherical co-ordinates.

2. The Static Electric Field:

Coulomb's Law, Electric Field strength, Field due to point charges, a line charge and a sheet of charge, field due to continuous volume charge, electric flux density, Gauss's law in integral form, Gauss's law in differential form (Maxwell's first equation in electrostatics), applications of the Gauss's law.

Electrostatic potential difference and potential, potential and potential difference expressed as a line integral, potential field of a point charge, potential field of a system of charges, conservative property, potential gradient, the dipole, energy density in the electrostatic field.

3. The static magnetic field:

The Biot-Savart's law (the magnetic field of filamentary currents), the magnetic field of distributed surface and volume currents, ampere's circuital law in integral and differential form (Maxwell's curl equation for steady magnetic field).

The scalar and vector magnetic potentials, Maxwell's Divergence equation for B, steady magnetic field laws, forces in magnetic field, force on a current element, force between two current elements, force and torque in a current loop.

4. The Electromagnetic field:

Faraday's law in integral and differential form (Maxwell's first curl equation for electro-magnetic field). The Lorentz force equation.

The concept of displacement current and modified ampere's law (Maxwell's 2^{nd} curl equation for electro- magnetic field), the continuity equation, power flow in an electromagnetic field, the boynting vector.

Sinusoidally time varying fields, Maxwell's equation for Sinusoidally time varying fields, Power and energy considerations for Sinusoidally time varying fields.

The retarded potentials, polarization of vector fields, review of Maxwell's equations.

5. **Materials and fields (review type only):**

Current and current density, the continuity equation, conductor in fields.

Dielectrics in fields: Polarization, flux density, electric susceptibility, relative permittivity, boundary conditions in perfect dielectrics, magnetic materials, magnetization, permeability, boundary conditions.

6. **Applied Electromagnetic I :**

Poisson's and Laplace's equations, solution of one-dimensional cases, general solution of Laplace's equation, method of images.

7. Applied Electromagnetic II:

Electromagnetic waves, the Helm Holtz Equation, wave motion in free space, wave motion in perfect lossy dielectrics, propagation in good conductors, skin effect
Reflection of uniform plane waves.
Radiation of electromagnetic waves.

8. Transmission line equations and parameters:
Some examples of transmission lines.

Books:

1. Hayt: Engineering Electromagnetics.
2. N. N. Rao: Basic Electromagnetics with applications.
3. Corson and Lofrain: Introduction to Electromagnetic Fields and waves.
4. Bradshaw and Byatt: Introductory Engineering Field Theory.
5. Nussbaum: Electromagnetic theory for engineers and scientists.

EE 644: Electric Power System-II.

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

1. **Static Substation:**

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/ power and overvoltage circuit diagrams and operation.

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.

L T P

EE643: Microprocessors and Applications (EE/IE) (3 1 3)

Full marks: Theory = 100
Sessional =50
Lab=50

1. **Microprocessor Architecture**:

Introduction to the microprocessor. The ALU. Up registers. Basic concepts of programmable device – Bus organization, system components etc. The interface section. The timing and control section. State transition sequence. Block diagram.

2. **Programming Microprocessors**:

Data representation, instruction formats, addressing modes, Instruction set, software design, assembly language programming, program looping, subroutine linkage, position independency, recursion.

3. **Memory Interfacing**:

Main memory types, memory characteristics compatibility between memory and up system bus, address space and its portioning, standard vs. system memories, address decoding, Dynamic RAM interfacing, Quasi- static RAMS, memory mapping and management.

4. **Data transfer**:

Programmed data transfer, DMA mode of data transfer, I/O part, device polling in the interrupt mode, DMA controller, serial mode of data transfer, some standard interfaces.

5. **I/O devices:**

OPAMPS, Opto-couples, DAC, ADC, sample& hold amplifiers, multiplexers, buffers, Timer counter, Data acquisition systems.

6. Support LSIS:

8255, 8155, 8253, 8279 etc

7. **Microprocessor based system design**:

A system of practical relevance to be chosen and described,
e.g- speed controller of de motor,
- A traffic light controller,
- Temperature monitoring & controller,
- ECG data acquisition & monitoring.

EE 646: Signals and Systems.

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

1. **Introduction:**

   Definitions. Continuous and Discrete-time signals. Systems and their classification.

2. **LTI Systems:**

   Continuous-time LTI systems: the Convolution integral. Discrete-time LTI systems: the Convolution sum. Properties of LTI systems. Systems described by differential and difference equations.

3. **Fourier analysis for continuous-time case:**

   Response of LTI systems to complex exponential. Representation of periodic signals: the Fourier series. Representation of a-periodic signals: the Fourier Transform and its properties. System analysis by Fourier Transforms.

4. **Fourier analysis for Discrete-time case :**

   Response of LTI systems to complex exponential. Discrete-time Fourier series. Discrete-time Fourier Transform and its properties. System analysis.

5. **Sampling :**

   The sampling theorem. Effect of under-sampling. Reconstruction of a signal from its samples using interpolation. Spectrum of sampled signal.

6. **Z-transform :**

   Definitions. The region of convergence. Properties of Z-transform. Inversion of Z-transforms. Application to system analysis.

7. **Digital Filters** :

   Frequency selective filters. FIR and IIR filters.

Books:

1. Oppenheim, Willisky, Nawab: Signals and Systems, PHI (India)
2. Oppenheim, Schafer: Digital Signal Processing, PHI (India)
3. Eugene Xavier: Signals, Systems & Signal Processing, S. Chand & Co.
4. Roberts: Signals and Systems, Tata McGraw Hill.
5. Mastering MATLAB, Pearson Education (for Laboratory use).