6) ELECTRICAL SCIENCES

PART A

1. Engineering Mathematics:

Linear Algebra: Matrices and Determinants, Systems of linear equations, Eigen values and Eigen Vectors

Calculus: Limit, Continuity and Differentiability; Partial Derivatives; Maxima and Minima ; Sequences and Series; Test for convergence; Fourier series.

Vector Calculus: Gradient; Divergence and Curl; Line; Surface and Volume integrals; Stokes, Gauss and Green's theorems.

Differential Equations: Linear and non-linear first order ODEs; Higher order linear ODEs with constant coefficients, Cauchy's and Euler's equations; Laplace transforms; PDEs – Laplace, heat and wave equations.

Probability and Statistics : Mean, median, mode and standard deviation; Random variables; Poisson, normal and binomial distributions; Correlation and regression analysis.

Numerical Methods: Solutions of linear and non-linear algebraic equations; Integration of trapezoidal and Simpson's rule; single and multi-step methods for differential equations.

2. Electric Circuits & Fields:

Network Topology : Graph of Network, concept of tree, links, tie set schedule, cutset schedule

Circuit Concepts: Source transformation, circuit analysis using loop current and node voltage methods, star-delta conversion, dual networks and concept of controlled sources. Network theorems, Resonant circuits, locus diagrams, Coupled circuits, polyphase circuits. Laplace transformations and applications, Non sinusoidal waveforms, initial conditions.

Network Functions: Network functions of one and two port networks, driving point & transfer functions, concepts of poles and zeroes.

Two-port Network: Y and Z Parameters and h –Parameters of two port networks. PR functions & Hurwitz Polynomial, Gauss's theorem, electric field intensity and plane charges, capacitance of parallel plates and coaxial cylinders. Ampere's and Biot-Savart's laws, inductance of long and short solenoids.

3. Analog & Digital Electronics:

Analog Electronics: Transistor biasing and bias stability, Class A, Class B & Class C Amplifiers, small signal h-parameter equivalent circuit of transistor. Expression for current gain, voltage gain, input impedance. RC coupled amplifier, frequency response, half power frequencies, bandwidth, factors influencing the bandwidth

RC Coupled emitter follower amplifier, current gain, voltage gain, input & output impedance, applications

FET-RC coupled Amplifier:

Power Amplifiers: Class A, Class B, push pull and Class C power amplifiers, max power output Driving power requirements.

Feed back amplifiers & oscillators: Concept of positive & negative feed back advantages of negative feedback. Voltage & current feed back, effect of the same on performance characteristics. Condition for oscillation, Weinbridge oscillator, expression for frequency of oscillation, Crystal oscillators, voltage regulator, operational amplifiers, comparator, ZCD, precision rectifier, I to V & V to I converters, instrumentation amplifiers, square wave, triangular wave & saw tooth wave generator.

Wave shaping circuits: Clipping, Clamping, integrator & differentiator circuits.

Digital Electronics: Digital signals, Boolean constants and variables, Basic logic operations, AND. OR, NOR gates and realization or truth tables, Boolean expressions, simplification.

Number Systems & codes: Decimal, binary, octal, hexadecimal, binary coded decimal; octal, hex numbers. Excess 3 and Gray codes, binary arithmetic.

Karnaugh map method of obtaining logic expressions, maxterm, minterm realization of logic functions using basic gates & also using NAND & NOR gates. Half adder, Full Adder.

Flip- Flops: R-S flip-flop, Clocked R-S, D-FF, JK, Master Slave JK-FF, Edge triggered flip-flops

Sequential Logic : Registers, Shift registers, asynchronous counters, synchronous counters sequential circuits. A/D and D/A converters, Multiplexers, Demultiplexers.

Semiconductor memories : RAM, ROM, PROM, EPROM, and EEPROMS

4. Control Systems:

Basic control system concepts, transfer function, Block Diagram reduction, signal flow graph, DC & AC servomotors & their TF; analogous systems F-V, F-I analogies, Time domain and frequency domain analysis.

Stability : Absolute and relative stability, RH criterion. Polar plots, phase cross over & gain cross over frequencies.

Bode plots, phase plot and gain plot, determination of gain and phase margins Nyquist stability criterion: Principle of mapping of Nyquist path, gain margin, phase margin. Nyquist stability criterion. Root locus.

State space technique, state variables, state model of linear systems, solution of state equation, state transition matrix.

5. Microprocessors:

8085 architecture, Instruction set, Addressing modes, Timing Diagram.

Programming : Main and subroutine programs, Conditional call and return, counter and delay subroutines

Interrupts : Vector interrupts, interrupts routines, Restart instructions.

Memory & I/O Interfacing : Memory map and I/O map methods & interfacing devices, 8255 (PPI), 8253(PIT), 8259(PIC). Architecture and Instructions of 8 bit micro controller.

MODEL QUESTIONS
SECTION – I OF Part - A

Each questions carries One mark

1) The number of two-input NAND gates required to realize XOR gates. Is
(a) 3 (b)4 (c) 2 (d) none of the above

2) Viscous friction coefficient equivalent in Force-voltage analogy is given by
(a) voltage (b) charge (c) Resistance (d) Inductance

3) The stability margin and steady-state behaviour can be achieved by
(a) lag and lead compensators respectively
(b) lead compensator only
(c) lag compensator only
(d) lead and lag compensator respectively

4) 8259 IC is used in 8085up based system to
(a) enable peripherals
b) to enable key board
(c) to increase the number of interrupts
(d)to enable keyboard and display

5) Tunnel diodes and varactor diodes are used in
(a) frequency control and voltage regulation respectively
(b) Microwave generation and frequency control
(c) voltage regulation
(d) none of the above

SECTION – II OF Part - A

Each questions carries Two marks

1) Four identical stages of amplifier with lower and upper cut off frequencies of 200Hz and 200KHz are cascaded. The 3 dB frequencies of the cascaded stage are
(a) 46Hz and 87KHz
(b) 50Hz and 50KHz
(c) 460 and 87KHz
(d) 800Hz and 87KHz

2) An amplifier with a gain of 500±x ia available. With 9.9% negative feedback, the variation in gain is reduced to ±0.1 %. Find x and feedback gain A_f.
(a) 0.25% and 9.9
(b) 0.51% and 9.9
(c) 9.9% and 0.51
(d)0.51 and 9.9

3) The step response of a system with H(s)= 1 /(s+ 1) is given by

(a) (l-e^{t}) u(t) (b)u(t)- e^{-t} (c) (l-e^{-t}) u(t) (d) (l-e^{t}) u(t)

4) An RC differentiator, at two times the cut-off frequency, will have a phase angle (in degree) of

(a) 60 (b) 63.43 (c) 26.57 (d) 45

5) A230V/12V transformer has 90% efficiency. It feeds 10 W load. The primary current is

(a) 4.8mA (b) 0.48mA (c) 0.48A (d) 48mA