6) ELECTRICAL SCIENCES

Syllabus and Model Question Paper

Syllabus

PART-A

1. **Engineering Mathematics:**

   Linear Algebra: Matrices and Determinants, **Rank of matrix**, Systems of linear equations, Eigen values and Eigen vectors.

   Calculus: Limit, Continuity and Differentiability. Partial Derivatives, Test for convergence, Fourier series.

   Vector Calculus: Gradient, Divergence and curl. Line, Surface and Volume integrals; Stokes theorem, Problems related to 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.

   Partial Differential Equations: PDEs, formation of PDEs, solution of PDE by direct integration and separation of variables. Heat and wave equations.

   Transforms: Laplace transforms, Fourier transform and Z-transform.

   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; Numerical solutions of ordinary differential equations.

2. **Electric Circuits and 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 - Thevenin's, Norton, Maximum power transfer, superposition and reciprocity, Resonant circuits, Transient analysis, Laplace transformations and applications, Standard test signals, Initial conditions.

   Two-port Network: y and z Parameters and h-Parameters of two port networks.

   Errors in Measurement- Types of errors and sources of errors.

   Electric filed- Coulomb's law and electric field intensity, Electric flux density.

3. **Analog and Digital Electronics:**

Analog Electronics:

Diode Circuits, Rectifiers, 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 and 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, Maximum power output, Driving power requirements.

Feedback Amplifiers & Oscillators: Concept of positive and negative feedback, advantages of negative feedback. Voltage & current feedback, effect of the same on performance characteristics. Condition for oscillation, Wein bridge 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:

Number Systems & codes: Decimal, Binary, Octal, Hexadecimal, Binary coded decimal, Octal, Hex numbers, Excess 3 and Gray codes, Binary arithmetic.

Digital Circuits: Combinational Logic Circuits: Digital signals, Boolean constants and variables, Basic logic operations, AND, OR, NOR gates and realization or truth tables, Boolean expressions, Simplification of Boolean Expressions using basic theorems, 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, Multiplexers, Demultiplexers, Encoders & Decoders, A/D and D/A converters,

Sequential Logic: SR Latch, Clocked RS FF, D FF, JK & T FF, Master Slave JK-FF, Edge triggered flip-flops, Registers, Shift registers, Asynchronous counters, Synchronous counters.

Semiconductor Memories: RAM, ROM, PROM, EPROM, EEPROM and Flash.

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. **8051 Microcontroller:**
Microprocessor Vs Microcontroller, CPU Architectures-Von-Neumann, Harvard, CISC and RISC.

8051 Microcontroller: Architecture, Memory organization, Addressing modes, Instruction set.

8051 Programming: Assembly language programs, Time delay calculations and subroutines.

8051- Interrupts, Timers/Counters, Serial Communication.

8051 Memory Interfacing and I/O Interfacing.

MODEL QUESTIONS
SECTION -I of Part –A

Each questions carries One mark

1) *If* $u=x^2+2xy+y^2+x+y$, then $x\frac{\partial y}{\partial x}+y\frac{\partial u}{\partial y}$ is equal to

(a) $2u$ (b) u (c) 0 (d) None of the above

2) Superposition theorem is applied to

(a) linear bilateral network (b) linear multiple source circuit
(c) linear single source circuit (d) linear two terminal network

3) The number of two-input NAND gates required to realize XOR gates is

(a) 3 (b) 4 (c) 2 (d) none of the above

4) The characteristic equation of a system is given as $3s^4+10s^3+5s^2+2=0$. This system is

(a) Stable (b) Marginally stable (c) Unstable (d) Linear

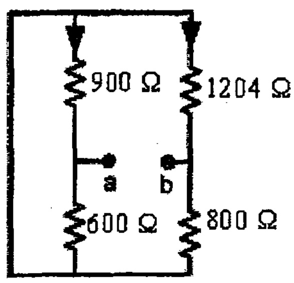
5) For 8051 Microcontroller, which of the following statement is not true?

(a) it has internal clock generator
(b) it has 128 bytes of internal RAM
(c) its' JZ instruction checks Zero flag of PSW
(d) it has NOP instruction

MODEL QUESTIONS
SECTION -II OF Part –A

Each questions carries Two marks

1) The value of R_{ab} for the following circuit is



(a) 420.32 Ω (b) 840.64 Ω (c) 205.83 Ω (d) 3504 Ω

2) If A is the following Matrix, then the Eigen values of A^{-1} are

$$\begin{bmatrix} 1 & 2 & 3 \\ 0 & 2 & 5 \\ 0 & 0 & 3 \end{bmatrix}$$

(a) 2, 3/4, 1/3

(b) 1, 1/2, 1 3

(c) 1/2, 1/2, 1

(d) 1/3, 1/2, 1

3) An amplifier with a gain of 500±x is 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) 051% and 9.9 (c) 9.9% and 0.51 (d) 0.51 and 9.9

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

(a) $(1-e^{t})\,u(t)$ (b) $u(t) - e^{-1}$ (c) $(1-e^{-t})\,u(t)$ (d) $(1-e^{t})\,u(t)$

5) Time taken by 8051 connected with a XTAL frequency 12 MHz to execute the following two instructions is

```
        MOV R1, #03H
LOOP:   DJNZ R1, LOOP
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(a) 4 μsec (b) 5 μsec (c) 6 μsec (d) 7 μsec