

CS-25/06

ELECTRICAL ENGINEERING

Paper—II

Time : Three Hours

Full Marks : 300

*Candidates should attempt Question No. 1 from Section-A and Question No. 5 from Section-B which are compulsory, and any **THREE** of the remaining questions, selecting at least **ONE** from each Section.*

All questions carry equal marks.

SECTION—A

1. Answer any **THREE** of the following :— $3 \times 20 = 60$
 - (a) What is meant by distortion factor ? How can this factor be measured ? Explain with the help of a block diagram.
 - (b) Explain what is meant by hysteresis in magnetic core materials and what Deltamax cores are ?
 - (c) What is meant by global warming and what are its after effects ? Explain the term greenhouse gases and green power.

(d) Explain the arc interruption process in air-break circuit breakers incorporating arcing horns and arc splitters.

2. (a) Differentiate between an open loop and closed loop control system and explain why closed loop systems are preferred for precision applications. Draw the block diagram of a feedback control system and explain the terminologies used. 20

(b) A simple closed loop system is defined by the relation :

$$T_m \frac{d^2\theta_0}{dt^2} + \frac{d\theta_0}{dt} = K_v \varepsilon \text{ and } \varepsilon = \theta_i - \theta_0.$$

T_m is the motor time constant and K_v is the velocity constant in radian/sec. The system is defined as above and subjected to an input $\theta_i u(t)$.

The response to this disturbance was found to be

$$\theta_0 = \theta_i [1 + 0.207e^{-60.6t} - 1.200e^{-10.4t}].$$

Determine the damping ratio ξ , the velocity constant K_v and motor time constant T_m . Suppose the velocity constant K_v , where to be increased until the damping ratio

$\xi = 0.707$. Find the new natural frequency W_n and velocity constant K_v . 20

(c) Describe the operation of a piezo-electric transducer. Name different types of photo-electric transducers and differentiate between photo-emissive, photo-conductive and photo-voltaic transducers. 20

3. (a) Determine the maximum value of a load which consumes 600 KWh per day at a load factor of 0.45. If the consumer increases the load factor to 0.65 without increasing maximum demand, determine the consumption of energy in kWh. 20

(b) Describe the principle of Merz Price systems of protection applied to a power transformer. What are the difficulties experienced and how are they overcome ? 20

(c) What is Fortescue's theorem and where it is applied ? Explain the terms : positive, negative and zero sequence components of currents. Determine the symmetrical components of the three line currents;

$$I_a = 10, I_b = 10 \text{ and } I_c = 10. \quad 20$$

4. (a) Draw the wind energy conversion system and briefly explain each component. Wind at 1 atmospheric pressure and at 15°C has a velocity of 10 m/s. The turbine has a diameter of 120 m and its operating speed is 40 rpm at maximum efficiency. Calculate (i) Total power density in the wind system (ii) Maximum obtainable power density assuming efficiency of 40% (iii) Total power produced in kW. 20

- (b) Derive an expression for the maximum power output from an MHD generator. With the following specification for an MHD generator, calculate open circuit Voltage, Power output of a load factor of 0.6 and maximum power output per unit volume :—

Plate Area (A) = 0.25 sq. m.

Distance between plates (d) = 0.4 meter

Flux density (B) = 2 Web./m²

Average Gas velocity (u) = 103 m/s

Gas conductivity = 10 mohs/m.

20

- (c) Define and explain the terms energy conservation and energy audit. Discuss the energy conservation measures (ECM's). 20

SECTION—B

5. Answer any **THREE** of the following :— $3 \times 20 = 60$

- (a) What is an interrupt ? Is it advantageous to have more interrupt levels ? If so why ? Explain the interrupt structure available in Intel—8085.

- (b) List possible ways of growing an oxide on a substrate without forming oxidation-induced stacking faults.

- (c) Draw the waveforms of horizontal and vertical synchronizing blocks. How are they separated from composite signal ?

- (d) What are blind speeds ? Discuss the methods of overcoming the problem of blind speeds.

6. (a) Find the empirical formula for LPCVD silicon nitride containing 5 at % H and having a Si/N ratio of 0.75. 20

- (b) Explain the binary ASK signalling scheme. Derive an expression for bit error probability of non-coherent ASK receiver. 20

- (c) What is a subroutine ? How does it differ from a macro ? Explain how subroutine call is handled in 8085. 20
7. (a) Derive the radar range equation and discuss various factors that influence range. 20
- (b) The polynomial $G(x) = x^4 + x + 1$ is the generator for (15, 11) Hamming binary code. Determine the generator matrix 'a' for this code in symmetric form. 20
- (c) Consider a discrete memoryless source having an alphabet with 5 symbols whose probabilities are listed below :—

Symbol	Probability
X_1	0.10
X_2	0.20
X_3	0.30
X_4	0.15
X_5	0.25

Derive the Huffman code for this source and compute the average code word length. 20

8. (a) What is the difference between normal and keyed AGC and AVC in broadcast receivers ? Explain with a circuit diagram how keyed AGC system operates. 20
- (b) Calculate the number of modes at 820 nm in a graded index fibre having parabolic index profile, a 25 μm core radius, $n_1 = 1.48$ and $n_2 = 1.46$. 20
- (c) Derive an expression relating quantization noise and signal to noise ratio in PCM. 20