

ELECTRICAL ENGINEERING (Paper II)

Time Allowed : Three Hours

Maximum Marks : 300

QUESTION PAPER SPECIFIC INSTRUCTIONS

(Please read each of the following instructions carefully before attempting questions)

There are EIGHT questions divided in two Sections.

Candidate has to attempt FIVE questions in all.

Question Nos. 1 and 5 are compulsory and out of the remaining, any THREE are to be attempted choosing at least ONE question from each Section.

The number of marks carried by a question/part is indicated against it.

Wherever any assumptions are made for answering a question, they must be clearly indicated.

Word limit in questions, wherever specified, should be adhered to.

SECTION 'A'

1. Select any three of the following statements, read them carefully and identify the correct and the incorrect ones. Justify your answer using not more than 200 words in each case. **20×3=60**
- (a) State variable approach for analysis is applicable only to linear time invariant systems.
- (b) The problem of drift may assume very serious problems in electronic instrumentation system.
- (c) Power carrying capability of transmission lines decreases with increase in the length of transmission, and can be improved by providing shunt reactors.
- (d) Optical fibre is the best choice for heavy demand long line telephone communication systems.
2. (a) The open loop transfer function of a unity feedback system is given by
$$G(s) = k/(s(1+st_1)(1+st_2))$$

(i) Using the Routh–Hurwitz method, determine the necessary conditions for the system to be stable. (ii) Sketch the root locus diagram for the system described for positive values of k , t_1 and t_2 . Show how the root locus gets modified with addition of a zero. **20**
- (b) Incremental cost characteristics of two thermal plants is given by
$$dC_1/dP_{G1} = (60 + 0.2P_{G1}) \text{ Rs./MW-hr}$$
$$dC_2/dP_{G2} = (40 + 0.3P_{G2}) \text{ Rs./MW-hr}$$

Evaluate the sharing of a load of 200 MW for most economic operation. If the plants are rated 150 MW and 250 MW. what will be the saving in cost in Rs./hour in comparison to loading in the same proportion to rating? **20**
- (c) Describe the construction and principle of working of a solid-state and over-current relay. **20**
3. (a) Boron is doped in n-type Si wafer having 2×10^{22} phosphorus atoms m^{-3} through a circular window of $0.1 \mu\text{m}$ diameter for 10 minutes at 1100°C . The gaseous atmosphere of BH_3 used for doping provides the B concentration of 1×10^{23} atoms m^{-3} at the surface of the wafer. Estimate the location of the p-n junction beneath the surface. Given the diffusivity of B in Si at 1100°C is $4 \times 10^{-17} \text{ m}^2 \text{ s}^{-1}$. **20**
- (b) What is load flow solution? What is its significance in power system? Classify various types of buses in a power system for load flow studies. Explain, with a flow-chart, the computational procedure for load-flow solution using Gauss-Siedel method. **20**

- (c) What are solar concentrators? Describe various components of a solar concentrator giving their functions. 20
4. (a) One method of measuring a small capacitance C_x is shown in fig. 1. C_1 and C_2 are equal high-quality variable air capacitors. C_3 is a fixed high quality capacitance of much smaller value than maximum value of C_2 (about 1/10 of C_2). The following two balances are obtained (i) With switch S open, C_2 at its maximum value and C_1 is adjusted for balance. (ii) With switch S closed, C_1 left unaltered and C_2 is adjusted to C_2' to get a new balance Prove that
- $$C_x = (C_3^2(C_2 - C_2')) / ((C_2' C_2 + C_2' C_3 - C_2 C_3))$$
- If $R = 1000\Omega$, C_1 and C_2 are 1000 pF and $C_3 = 50$ pF and assuming the variable capacitors are readable to ± 5 pF with what accuracy could a capacitance of 1 pF be measured?
- [Figure: Fig. 1: Bridge with four arms between a top node, left node, right node and bottom node: upper-left arm R and upper-right arm R (from the left and right nodes to the top node); lower-left arm: variable capacitor C_2 from the left node in series with fixed capacitor C_3 to the bottom node; lower-right arm: variable capacitor C_1 from the right node to the bottom node; detector D between the top node and the bottom node; bottom node earthed. From the junction of C_2 and C_3 , switch S in series with C_x to earth. An ac source is connected across the left and right nodes; label W on the supply side.] 20
- (b) Discuss three kinds of error-detection codes and explain how they detect errors. 20
- (c) Explain with the help of block diagram a CW Doppler radar using an intermediate frequency in the receiver. Give its advantages applications and limitations. 20

SECTION 'B'

5. Select any three of the following statements, read them carefully and identify the correct and the incorrect ones. Justify your answer using not more than 200 words in each case. 20×3=60
- (a) Feedback provides same control on the steady state error to standard inputs by adjustment of open-loop gain.
- (b) One disadvantage of magnetic tape recorder is that its characteristics limit its use at higher frequencies.
- (c) The cost of fabrication and installation of system for utilizing solar energy is too high to be viable.
- (d) ICs, although cheaper, are less reliable as compared to discrete components interconnected by conventional techniques.
6. (a) A system is described by the following state and output equations
- $$\dot{X} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U$$
- And $Y = \begin{bmatrix} 1 & 0 \end{bmatrix} X$ where $u(t)$ is a unit step input and the initial conditions $X_1(0)=0$, $X_2(0)=0$. Obtain the time response of the system. 20
- (b) Briefly explain the principle of PCM, differential PCM and delta modulation. 20
- (c) Discuss salient features of a fibre optic communication system. List some of the optical components used to interconnect a digital voice or data systems. 20
7. (a) Discuss the functions of various Registers and ALU of 8085. 20
- (b) Discuss multiple access techniques for satellite communications. Explain the meaning of the following FDMA, TOMA, COMA and SOMA 20
- (c) Briefly describe two different types of phase array radars. How can phased arrays overcome the difficulties occasioned by the use of moving radar antennae? 20
8. (a) Give the construction, principle of working and apperceptions of an LVDT. 20
- (b) Develop receiver end power circle diagram of a transmission line. Explain, how from the power circle diagram, capacity of a synchronous phase modifier be determined. 20

(c) Establish block diagram for load-frequency control of an isolated power system.

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