

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 identity the correct and the incorrect ones. Justify your answer using not more than 200 words in each case: **20×3=60**
- (a) Routh-Hurwitz criterion is an algebraic method that provides information on the absolute stability of linear time invariant system that has a characteristic equation with constant co-efficient.
- (b) If a polyphase, load is supplied through 'm' conductors, the total power consumed is measured by adding the readings of 'm' wattmeters so arranged that current coil of a wattmeter is in each line and the corresponding pressure coil is connected between that line and a common point. If the common point is located on one of the lines, then the power may be measured by (m - 1) wattmeters only, irrespective of balanced/unbalanced load.
- (c) For economic operation, the generator with highest positive incremental transmission loss will operate at the highest positive incremental cost of production.
- (d) Considering state of the art, the communication links of satellites for weather forecasting are at present very effective.
2. (a) Explain the effects of negative feedback in control systems on the following (i) Stability (ii) External disturbances **20**
- (b) Define surge impedance of a line and discuss the advantages and disadvantages of operating an overhead line corresponding to surge impedance loading. Also explain the terms infinite line, flat line. **20**
- (c) Describe a few features of a wind wheel for efficient generation of electrical energy and discuss economic viability of this form of energy vis-a-vis conventional method. Which generator do you recommend and why? **20**
3. (a) Discuss briefly the architecture of 8086 microprocessor with special reference to the following (i) Memory organization (ii) Register structure (iii) Addressing modes **20**
- (b) Explain with reasons the connection of C.T.s for protecting a delta/star transformer Justify your scheme of protection for (i) internal fault and (ii) external fault, using Merz-Price protection. **20**
- (c) What is solar power? Describe very briefly with neat diagram the scheme for (i) residential cooling and heating and (ii) solar power plant, using solar energy. **20**

4. (a) Describe the factors on which the conductivity of intrinsic semiconductor depends. A semiconductor is made of 'n'-type germanium. From the following data, calculate the conductivity of 'n'-type germanium: (i) Density of Ge = $5.32 \times 10^3 \text{ kg/m}^3$ (ii) At. wt. of Ge = 72.6 kg/k.mol (iii) Charge of electron = $1.6 \times 10^{-19} \text{ C}$ (iv) Mobility of holes = $0.18 \text{ m}^2/\text{V.s}$ (v) Mobility of electrons = $3.8 \text{ m}^2/\text{V.s}$ (Assume one donor atom in each 10^8 atoms) **20**
- (b) Describe the basic modulation schemes in digital data transmission. **20**
- (c) Explain what is meant by saying that a satellite is stationary. Why are such satellites used for worldwide communications in preference to any other kind? **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) If the roots of characteristic equation of a linear digital control system lie within unity circle in z-plane, the system is stable. **20**
- (b) The magnetic property of a material is completely lost above its characteristic Curie temperature. **20**
- (c) The chances of arc interruption in subsequent current zero increase in case of air blast C.B. but decrease in oil C.B. **20**
- (d) The bandwidth of a PCM signal is much larger than that of original base band. **20**
6. (a) Explain how frequency can be measured using four arm bridge arrangement. Derive balance condition for such a bridge. Mention the range of frequency measurement and accuracy of such measurement. If applied voltage is non- sinusoidal, will it be possible to balance this bridge? **20**
- (b) Describe a communication circuit using modem and explain how modems are classified, **20**
- (c) Explain the significance of blind speed in moving target indicator (MTI) by radar. A MTI operates at 5 GHz with a pulse repetition frequency (PRF) of 400 pps. Calculate the lowest blind speed of radar. **20**
7. (a) Discuss the performances of proportional plus derivative and proportional plus integral controllers. **20**
- (b) Describe radar beacons and their application. **20**
- (c) What do you mean by bandwidth of single mode fibre and describe the factors on which it depends? **20**
8. (a) Explain the following (i) Gain margin (ii) Phase margin How are they determined from Nyquist plot and Bode plot? **20**
- (b) A generator is connected to a motor through a Y/Δ transformer. The generator is connected to the star side of the transformer. A fault occurs between the motor terminal and the transformer. The symmetrical components of the sub-transient current in motor flowing towards the fault are $I_{a1} : -0.8 - j2.6 \text{ p.u.}$, $I_{a2} : -j2.0 \text{ p.u.}$ and $I_{a0} : -j3.0$. From the transformer towards fault $I_{a1} : 0.8 - j0.4 \text{ p.u.}$, $I_{a2} : -j1.0 \text{ p.u.}$ and $I_{a0} : 0$. Assume $X'' = X_2$ for both the motor and the generator. Describe (i) the type of fault, (ii) the prefault current, if any, in line 'a'. **20**
- (c) Explain the terms energy management, energy audit and energy economics. Explain how these techniques can be used to improve the performance of an energy starved inter connected power system. **20**