

## 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. **3×20=60**
  - (a) Jury stability test states that if the first element of descending order polynomial, viz,  $a_0 > 0$ , then all roots of the polynomial  $Q(z)$  are inside the unit circle if and only if the first element in each odd-numbered row is positive in the derived array.
  - (b) Transducers are sensors having many classifications, advantages and applications.
  - (c) Very efficient operation and control of an interconnected power system is necessary and various levels of planning, and load control centers are required.
  - (d) 2:1 interlace ratio is used for interlaced scanning in television systems.
2. (a) State and explain the Mason's Gain formula. Determine all input-output relationships of the system represented by the set of following linear equations using the Mason's Gain formula:  $x_1 = a_{11}x_1 + a_{12}x_2 + b_1u_1$ , and  $x_2 = a_{21}x_1 + a_{22}x_2 + b_2u_2$  where  $u_1$  and  $u_2$  are the inputs and  $x_1$  and  $x_2$  are the states of the system. **20**
3. (a) Sketch and discuss the fabrication of a planar transistor made for monolithic integrated circuits using epitaxy and diffusion with that of a discrete planar epitaxial transistor. **20**
  - (b) Explain how the SCADA systems are techno economically feasible for Indian power systems. Point out the differences between loose-coupled SCADA system and tight-coupled SCADA system. Draw the diagrams of direct digital control system for power systems. **20**
  - (c) The time-current characteristic of an induction-type over current relay is

| I (multiples of pick up) | T (Seconds) |
|--------------------------|-------------|
| 2                        | 14          |
| 4                        | 6           |
| 6                        | 4.8         |
| 8                        | 4.1         |
| 10                       | 3.5         |
| 12                       | 3           |
| 16                       | 2.6         |
| 20                       | 2.5         |
| 30                       | 2.4         |

It is desired to determine the time of operation of a 5- ampere relay having a current setting of 125 per cent and give time-multiplier setting of 06 connected to a supply circuit **20**

through a C.T. ratio of 400/5 amperes when the circuit carries a fault current of 4000 amperes.

4. (a) What minimum functions are required in a programmable device? Point out the difference between control logic and control word with examples. Write the steps to compute the control word, say of 8255. 20
- (b) The relevant data for closed-circuit TV system is given below. Calculate the highest modulating frequency that will be generated while scanning alternate black and white dots for equal vertical and horizontal resolution. Data: Number of lines = 250, Interlace ratio = 1:1, Aspect ratio = 4:3, Picture repetition ratio = 50 per second, Resolution factor = 0.8, Vertical retrace time = 10% of picture frame time, Horizontal retrace time = 20% of total line time. 20
- (c) With the aid of a block diagram, explain the operation of FMCW radar altimeter. 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.

**3×20=60**

- (a) The memory mapping for the circuit shown below is 2000H to 20FPH, assuming  $A_8$ ,  $A_9$ , and  $A_{10}$  to be zero.  
 [Figure: 3-to-8 decoder with enable inputs  $E_1$  and  $E_2$  (both active-low, bubbles) driven by  $A_{14}$  and  $A_{15}$  respectively, and enable  $E_3$  (active-high) tied to +5 V; select inputs  $A_{13}$ ,  $A_{12}$ ,  $A_{11}$  (top to bottom); active-low outputs, of which  $O_4$  is connected to the active-low chip-select input ( $\overline{CE}$ ) of a peripheral chip; the chip also receives  $\overline{IO/M}$ ,  $\overline{ALE}$ ,  $\overline{(RD)}$ ,  $\overline{(WR)}$ , RESET, and is connected bidirectionally to  $AD_7 \dots AD_0$ .]  
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- (b) Electrical isolation different elements of a monolithic integrated circuit is obtained by creating isolation islands. 20
- (c) In a long transmission line, the sending-end voltage is always greater than the receiving-end voltage and this effect is known as Ferranti effect. 20
- (d) Transmission links using optical fibres need components with specific characteristics to fulfill the system requirements. 20
6. (a)(i) With a simple block diagram, explain basic swept receiver spectrum analyzer. List the spectra of different signals applied to the spectrum analyzer for analysis. 20
- (a)(ii) Draw basic elements of a function generator and its output waveforms. 20
- (b) Describe the basic elements of a PCM system. 20
- (c) Calculate the apogee and perigee heights for the orbital parameters given Eccentricity = 0002, Mean Earth's radius = 6378 km, Mean distance to the semi-major axis = 7100 km. 20
7. (a) Distinguish between (i) spontaneous and stimulated emission, (ii) step index and graded index optical fibre. 20
- (b) Bring out the concept of TDM with a block schematic. 20
- (c) A signal having a range of 300 to 3400 kHz is transmitted using binary PCM on a channel whose bit rate is 40,000 bits per second. Design the PCM system and draw the block diagram. 20
8. (a) Point out the advantages of frequency response studies of a system. Explain the Bode plots for the log magnitude versus frequency and phase angle versus frequency for the complex conjugate poles or zeros. 20
- (b) Draw and briefly describe a neat diagram schematic diagram showing the components of a bipolar point-to-point HVDC transmission system. Explain how the control of power transfer and of power-flow direction is achieved. 20

- (c) Describe microprocessor - based inverse - time over current (ITOC) relay with a neat schematic block diagram.

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