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Code—08

ELECTRICAL ENGINEERING

Time Allowed : 3 Hours *Maximum Marks : 150*

Note : Attempt any *Five* questions. All questions carry equal marks. Q. No. **1** is compulsory. Attempt *two* questions from Part I and *two* questions from Part II. The parts of the same question must be answered together and must not be interposed between answers to other questions.

1. Write critical notes on any *four* of the following : (4×7½=30)

(a) Power measurement in polyphase circuits.

(b) Characteristics of signals and properties of systems.

(c) Travelling wave and standing wave phenomenon in AC power transmission.

P.T.O.

(d) Thermistor characteristics and applications.

(e) 8085 Registers and Addressing modes.

(f) HVDC Power Transmission; merits, demerits and specific applications.

Part I

2. (a) Discuss the different biasing arrangement for CE amplifier configuration. Giving an example explain how a specific configuration is designed.

(b) Explain the methods of switching a thyristor in conducting mode. Explain the switching characteristics of a thyristor.

(c) Give a technical comparison of various power semi-conductor devices. Write in brief about the details of a power MOSFET and its function. (30)

3. (a) Discuss the advantages and disadvantages of single phase a.c. motors. Derive an equivalent circuit of a capacitor run single phase motor on the basis of double revolving field theory.

(b) Explain methods of conversion of 3 phase to two phase and single phase. Draw phasor diagram and give load analysis.

(c) A three phase a.c. voltage controller is used to start and control the speed of a 3 phase 100 hp, 460 V, four pole induction motor driving a centrifugal pump. At full load output the power factor of the motor is 0·85 and the efficiency is 85 per cent. The controller and motor are connected in delta. Determine :

(i) the r.m.s. current rating of the thyristor.

(ii) the peak voltage rating of the thyristor.

(iii) the control range of the furing angle α. (30)

4. (a) Three concentric spherical conductors, radii a, b, c, $(a < b < c)$ have charges E_1, E_2, E_3 respectively. Show that if the inner conductor is not earthed, the

potential of the conductors are diminished by amounts inversely proportional to their radii, and that loss of energy is :

$$\frac{a}{2}\left[\frac{E_1}{a}+\frac{E_2}{b}+\frac{E_3}{c}\right]^2$$

(b) Using Boolean matrices synthesize a bridge circuit starting from the transmission function $T = A\overline{C}\,\overline{D}\,\overline{E} + \overline{A}\,\overline{B}C\overline{E} + \overline{A}\,\overline{C}\,\overline{D}\,\overline{E} + ABCE$.

(c) Consider the following logical statements :

(i) Hubert never plays Tennis.

(ii) Joe plays Tennis if and only if, Hubert and Donald are present.

(iii) Sidney plays Tennis under all conditions even by himself.

(iv) Donald plays Tennis if and only if, Hubert is not present.

If A represents Hubert's presence on the court, B Joe's presence, C Sidney's and D Donald's, determine the function representing a state of no game taking place on the court. Express this function as a word statement. **(30)**

Part II

5. (a) Define gauge factor for a strain gauge. Explain its various types. A strain gauge made up of a material having gauge factor of 2 has resistance temperature coefficient of 12×10^{-4} /°C and resistance of 120 ohms. It is connected to a bridge having resistance of 120 ohm each. The bridge is balanced at ambient temperature. If the temperature changes by 15°C, find the (i) output voltage of the bridge if the input voltage is 10V and (ii) the equivalent strain represented by the change in temperature.

(b) What are Solar Cells ? Give a brief description of the structure, power output, V-I characteristics and limitations of solar cells. How are these cells utilised for P.V. electricity (Photo Voltaic) when connected to a power grid.

(c) What is the purpose of fault analysis on Power System ? Give the effect and classification of faults along with simplifying assumptions in carrying out fault analysis. Derive an expression for short circuit with 3 phase element *i-j* for a balanced three-phase network using Z_{bus}. (30)

6. (a) A power system has two generating plants and power being dispatched economically with $P_1 = 150$ MW and $P_2 = 275$ MW. The loss coefficient are $B_{11} = 0{\cdot}10 \times 10^{-2}$ per MW, $B_{12} = -0{\cdot}01 \times 10^{-2}$ per MW, $B_{22} = 0{\cdot}13 \times 10^{-2}$ per MW. To raise the total load on the system by 1 MW will cost an additional Rs. 200 per hour. Find (i) the penality factor for plant 1 and (ii) the additional cost per hour to increase the output of plant 1 by 1 MW. Give proof of the expression used.

(b) Give an account of engineering applications of wave analysers. Describe the circuits and working of wave analysers used for audio frequency and Megahertz ranges. Explain the various distortions caused by amplifiers.

(c) Explain the following terms pertaining to a transmission network primitive network, loop matrix, incidence matrix, cutset matrix, oriented graph and system graph. (30)

7. (a) Explain how the wind data monitoring, recording and analysis is performed. How variation of velocity and directions are represented by characteristic graphs and plots. Give an account of environmental impact of wind energy development.

(b) Explain how the left half of *s* plane is mapped into Z plane. Show the constant attenuation loci and constant damping

loci in both the planes corresponding to each other. Obtain the inverse of the function $F(Z) = \frac{1}{(z-1)(z-2)}$ by inversion integral method.

(c) Enlist important insulating materials and discuss the recent trends of insulating materials in modern electrical and electronic industry. (30)