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**HPAS (M)—2014**

**ELECTRICAL ENGINEERING**

**Paper II**

*Time : 3 Hours*

*Maximum Marks : 150*

*Note :— Attempt Five questions in all, taking at least one question from each Part. Question No. 1 is compulsory.*

**Part A**

1. (a) Define sensitivity. Also explain how feedback affect the sensitivity of system. 14
- (b) Derive the state equation of a system having transfer function as follows

$$\frac{Y(S)}{U(S)} = \frac{8}{S(S + 2)(S + 3)}$$

by cascade decomposition method.

16

P.T.O.

2. (a) A third order control system has the characteristic equation :

$$S^3 + 3408.3 S^2 + 120400 S + 1.5 \times 10^7 K = 0$$

Using Routh-Hurwitz's criterion, find the condition on K for the system to be stable. How many roots of the characteristic equation will lie in the right half of S-plane when

$$K = 280.$$

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- (b) Construct the SFG for the following set of equations :

$$Y_2 = G_1 Y_1 - G_2 Y_4$$

$$Y_3 = G_3 Y_2 + G_4 Y_3$$

$$Y_4 = G_5 Y_1 + G_6 Y_3$$

where  $Y_1$  and  $Y_4$  are the input and output respectively. Using Masson's gain formula, find the transfer function of the system. 15

### Part B

3. (a) Explain the Merz-Price differential protection for generator. Why does the relay sometimes tend to operate in case of heavy external fault ? 15

(b) Figure 1 shows three overcurrent and one earth fault schemes. An earth fault relay 64 is set to operate at 20% of relay rating. The setting range of earth fault relay is 10–40% of 1 A in

P.T.O.

seven equal steps. The excitation current of CT core is 30 mA. Find out the percentage of set current at which the relays will pickup. Find out PSM of relay 64 for fault currents of 50 A, 100 A and 200 A.

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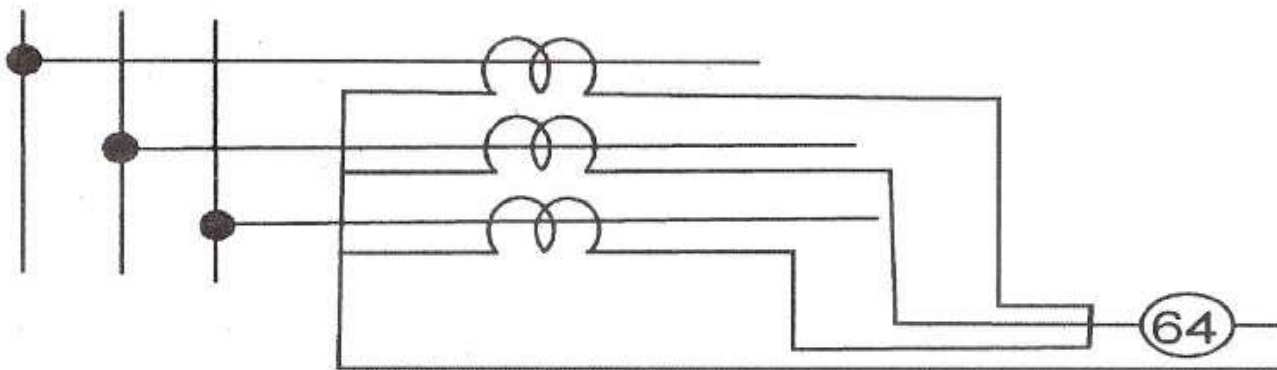


Fig. 1 Three overcurrent and one earth-fault schemes.

4.1 (a) How does environment get affected by the use of the following sources of energy ?

- (i) Solar Energy Sources
- (ii) Biomass Energy Sources
- (iii) Wind Energy.

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- (b) In a 3-phase unsymmetrical system, the line currents flowing towards a  $\Delta$  connected load are measured as :

$$I_a = 10.0 \angle -45^\circ$$

$$I_b = 10.0 \angle +90^\circ$$

Find the symmetrical components of line currents. 15

### Part C

5. (a) Describe briefly the reasons for using a sample and hold circuit in a microprocessor application for inputting an analog voltage. Also explain Handshaking and Buffers. 16
- (b) Discuss the issues related to grid interconnection of wind farms. 14



6. (a) Describe with a diagram and waveforms the operation of dual trace CRO in alternate and Chop mode. State the functions of each block.

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(b) A De-sauty bridge consists of the following :

Arm AB having a resistance of  $1 \text{ k}\Omega$ .

Arm BC having a capacitor value of  $0.75 \text{ }\mu\text{F}$ .

Arm AD having resistance of value of  $300 \text{ }\Omega$ .

Arm BD having unknown capacitor.

Determine the value of unknown capacitor. Also explain how inductors can be used as a transducer.

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**Part D**

7. (a) The resistivity of intrinsic germanium at  $28^{\circ}\text{C}$  is equal to 0.45 ohm-m. Assuming electron and hole mobilities of respectively 0.38 and  $0.17 \text{ m}^2\text{-volt}^{-2} \text{ sec}^{-1}$ , calculate the intrinsic carrier density  $n_i$  at  $28^{\circ}\text{C}$ . 15
- (b) Compare various methods used for the deposition of thin film in microelectronics. 15
8. (a) Consider a 4-bit PCM coded system. The normalized peak-to-peak input voltage range is  $\pm 15 \text{ V}$  for a uniform quantization would have yielded better results. 15
- (b) Compare the main features of linear and non-linear digital modulation techniques. 15