

This question paper contains 4+2 printed pages]

HPAS (Main)—2013

ELECTRICAL ENGINEERING

Paper II

Time : 3 Hours

Maximum Marks : 150

Note :— Attempt five questions in all, taking at least one from each Part. Part A is compulsory.

Part A (Compulsory)

1. (a) Find the overall transfer function using Mason's gain formula of the system whose block diagram is shown in Fig. 1.

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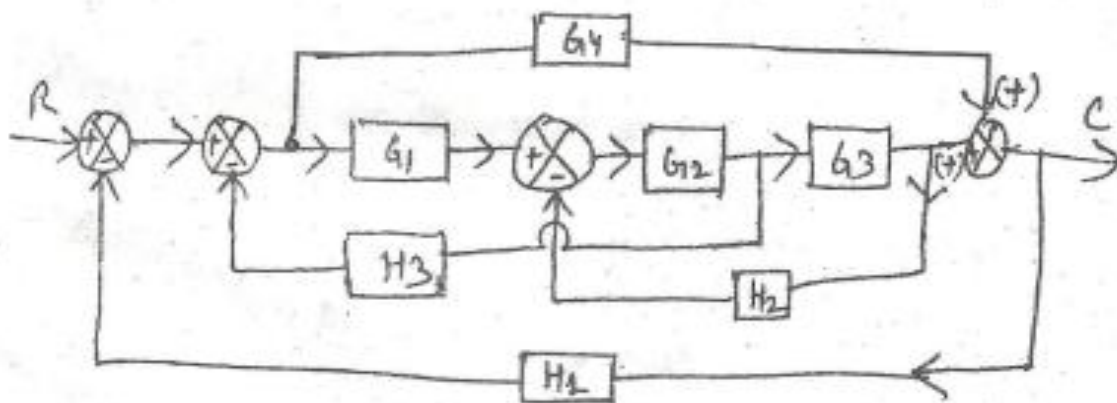


Fig. 1 : Block diagram

P.T.O.

- (b) Discuss the methodology for detailed energy audit.

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2. (a) A system is governed by the following differential equation

$$\frac{d^3y}{dt^3} + 5\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 10y = 7 u(t)$$

where y is the output and u is the input to the system. Obtain a state space representation of the system.

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- (b) Write notes on :

- (i) Soft magnetic materials
- (ii) Hard magnetic materials
- (iii) Hysteresis loop.

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Part B

3. (a) Discuss various equality and inequality constraints for economic operation of electric power system.

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(b) An overhead line at a river crossing is supported from two towers of height 30 meters and 90 meters above water level with a span of 330 metres. The weight of the conductor is 1 kg/metre and working tension is 2000 kg. Determine the clearance between the conductor and water level mid-way between towers. 15

4. (a) (i) Explain why it is necessary to maintain the frequency of the system constant. 5
- (ii) Compare the steady state and dynamic operations of an isolated system. 10

(b) A constant load of 400 MW is supplied by two 210 MW generators 1 and 2, for which the fuel cost characteristics are given as below :

$$C_1 = 0.05 P_{G_1}^2 + 20P_{G_1} + 30.00 \text{ Rs./hr}$$

$$C_2 = 0.06 P_{G_2}^2 + 15P_{G_2} + 40.00 \text{ Rs./hr}$$

P.T.O.

The real power generations of unit P_{G_1} and P_{G_2} are in MW. Determine :

- (i) The most economical load sharing between the generators.
- (ii) The saving in Rs./day thereby obtained compared to the equal load sharing between two generators.

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Part C

5. (a) Explain the principle of Merz-price system of protection used for power transformers. What are the limitations of this scheme and how are they overcome ?
- (b) With the help of block diagram explain various states of power system.

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6. (a) Explain how the following adjustments are made in a single phase induction type energy metre :

(i) Creep

(ii) Adjustment for friction

(iii) Overload compensation.

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(b) A barium titanate pickup has the dimensions of 5 mm × 5 mm × 1.25 mm. The force acting on it is 4.5 N. The charge sensitivity of barium titanate is 150 pC/N and its permittivity is 12.5×10^{-3} F/m. If the modulus of elasticity of barium titanate is 12×10^6 N/m², calculate the strain, charge and the capacitance.

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P.T.O.

Part D

7. (a) What are the advantages and disadvantages of reactive ion etching versus sputter etching? Cite a hypothetical example of when you might want to use sputter etching rather than RIE. 16
- (b) Draw the basic block diagram of a color television transmitter; and briefly explain the function of each block. 14
8. (a) Explain why quantizing noise could affect small amplitude signals in PCM system far more than large signals. With the aid of sketches, show how tapered quantizing levels could be used to counteract this effect. 16
- (b) Write notes on (i) optical properties of fibre optic materials (ii) frequency keying schemes. 14