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Seat No.	
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**T.E. (Electrical) (Sem. – VI) (New) Examination, 2011
POWER SYSTEM STABILITY AND CONTROL**

Day and Date: Wednesday, 18-5-2011
Time: 2.30 p.m. to 5.30 p.m.

Total Marks: 100

- Instructions :** 1) Solve **any three** questions from Section – I and **any three** questions from Section – II.
2) Use of non-programmable calculator is **permitted**.
3) Assume **suitable data wherever necessary**.

SECTION – I

1. A 60 Hz alternating voltage having a rms value of 100 V is applied to a series RL circuit by closing a switch. The resistance is $15\ \Omega$ and the inductance is 0.12 H.
- a) Find the value of DC component of current upon closing the switch if the instantaneous value of voltage is 50 V at that time.
 - b) What is the instantaneous value of the voltage which will produce the maximum DC component of current upon closing the switch ?
 - c) What is the instantaneous value of the voltage which will results in absence of any DC component of current upon closing the switch ?
 - d) If the switch is closed when the instantaneous voltage is zero, find the instantaneous current 0.5, 1.5 and 5.5 cycles latter. 16
2. a) If the symmetrical components of voltages to neutral are $V_1 = 50\angle 0^\circ$, $V_2 = 20\angle 90^\circ$ and $V_0 = 10\angle 180^\circ$, determine the voltages to neutral. 8

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- b) Obtain the relationship between the line and phase voltages and currents of symmetrical components for star and delta circuits. Draw neat phasor diagram. 8
3. a) Derive the sequence circuits for synchronous machine. 8
- b) Obtain the zero sequence network of the power system shown in Fig. 1

Reactances of the two sections of the transmission line are shown on the diagram.

The generators and transformers are rated as follows :

Gen 1 : 20MVA, 13.8 kV, $X''_d = 0.20$ per unit

Gen 2 : 30 MVA, 18 kV, $X''_d = 0.20$ per unit

Gen 3 : 25 MVA, 20 kV, $X''_d = 0.20$ per unit

T_1 : 25 MVA, 220Y/13.8 Δ kV, $X = 10\%$.

T_2 : single phase units, each rated 10 MVA, 127/18 kV, $X = 10\%$

T_3 : 35 MVA, 220Y/22Y kV, $X = 10\%$

The neutral of Gen. 1 and 3 are connected to ground through current limiting reactors having reactance of 5%, each on the base of the machine to which it is connected. Each generator has zero sequence impedance of 5% to its base. The zero sequence reactance of transmission line is 210 Ω from B to C and 250 Ω from C to E.

Select the system base as 50 MVA.

10

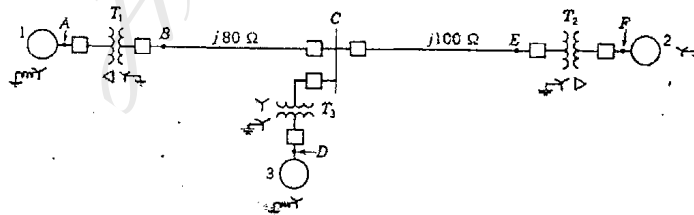


Fig.1 : Power system for Q. 3.b)



4. a) Discuss the method of analyzing line to line faults. **8**
b) What is need of AGC ? Explain AGC for single area. **8**

SECTION – II

5. a) Derive the formulation for economic dispatch neglecting losses and no generator limits for the generating plant with n units. **8**

- b) The fuel cost functions for three thermal units in a plant in Rs./h are given by :

$$C_1 = 500 + 5.3 P_1 + 0.004P_1^2$$

$$C_2 = 400 + 5.5 P_1 + 0.006 P_2^2$$

$$C_3 = 200 + 5.8 P_1 + 0.009P_3^2$$

Where $P_1, P_2,$ and P_3 are in MW. The total load P_D , is 800 MW. Neglecting line losses and generator limits, find the optimal dispatch and total cost in Rs./h. **10**

6. a) With suitable example explain optimal unit commitment. **8**

- b) For the economic operation of thermal plants including transmission losses prove that for i^{th} generating plant.

$$(IC)_i = \lambda_i [1 - (ITL)_i]$$

Where

$(IC)_i$ = incremental cost of i^{th} plant

λ_i = Lagrangian multiplier for i^{th} plant

$(ITL)_i$ = incremental transmission loss for i^{th} plant. **8**



- 7. a) State and prove the swing equation from the first principles of rotor dynamics. 8
- b) The single line diagram of system is shown in Fig. 2. The machine is delivering 1.0 per unit power and both the bus voltages are 1.0 per unit. Numbers on the diagram indicates the values of the reactances on a common system base. The transient reactance of the generator is 0.20 per unit as indicated. Determine the power angle equation for the given system operating conditions. 8

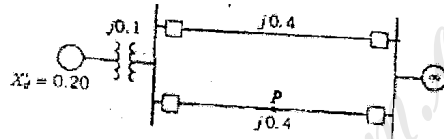


Fig. 2 single line diagram for Q7. b)

- 8. a) Explain the methods of improving voltage stability of a system. 8
- b) What is the need of contingency analysis of a power system ? 8

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