C 28737 **(Pages : 3)** Name..............................

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SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION
JUNE 2012

EE 04 604—POWER SYSTEMS II

Time : Three Hours Maximum : 100 Marks

PART A

8 x 5 = 40 Marks

I. a) Formulate Z_{bus} for the system in Fig. 1. Treat bus 1 as reference.

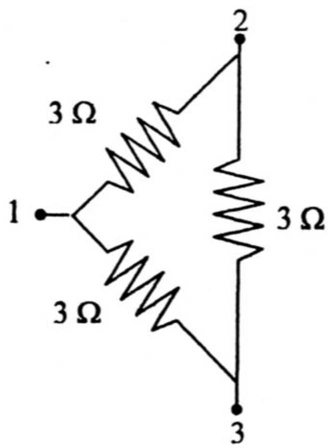

Fig. 1

b) Explain the need for using acceleration factor in load flow studies using Gauss-Seidal method.

c) The fuel inputs per hour of plants 1 and 2 are given as

$$F_1 = 0.2P_1^2 + 40P_1 + 120 \quad \text{Rs. per hour}$$

$$F_2 = 0.25P_2^2 + 30P_2 + 150 \quad \text{Rs. Per hour}$$

Determine the operating schedule and the corresponding cost of generation if the maximum and minimum loading on each unit is 100 MW and 25 MW, the demand is 180 MW, and transmission losses are neglected If the load is equally shared by both the units, determine the saving obtained by loading the units as per equal incremental production cost.

d) Explain with the block diagram, the simplified automatic voltage regulator.

e) The symmetrical components of a set of unbalanced three phase currents are

$$I_a^0 = 3\angle{-30^0}\ \text{A};\ I_a^1 = 5\angle 90^0\ \text{A};\ \text{and}\ I_a^2 = 4\angle 30^0\ \text{A}.$$

Obtain the original unbalanced phasors.

f) Explain why are prefault currents usually neglected in fault computation.

g) Starting from first principle, derive the swing equation of a synchronous machine.

h) Differentiate between voltage stability and rotor angle stability.

Turn over

PART B 4 x 15 = 60 Marks

II. A. Two synchronous machines are connected through three phase transformers to the transmission line, as shown in Fig 2. The ratings and reactances of the machines and transformers are

Machine 1 and 2 : 100 MVA, 20 kV; $X_1 = X_2 = 20\%$; $X_0 = 4\%$; $X_n = 5\%$

Transformers T_1 and T_2 : 100 MVA, 20 Δ / 345 Y kV; X = 8%

On a chosen base of 100 MVA, 345 kV in the transmission line circuit the line reactances are $X_1 = X_2 = 15\%$ and $X_0 = 50\%$. Draw each of the three sequence networks and find the zero sequence bus impedance matrix by means of the Z_{bus} building algorithm. (where X_1 = positive sequence reactance, X_2 = negative sequence reactance, and X_0 = zero sequence reactance).

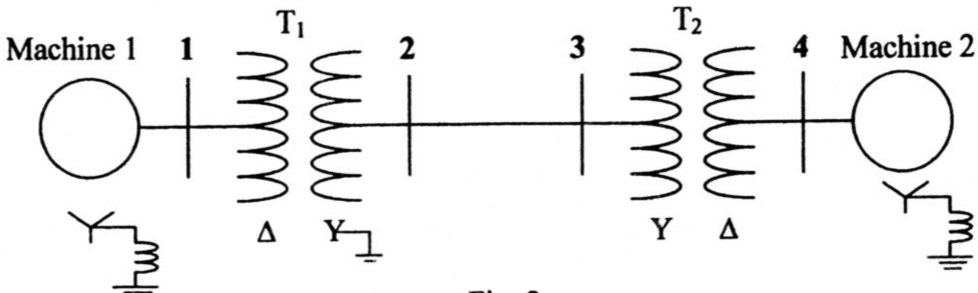

Fig. 2

OR

B. The line admittances of a four bus system are

Bus code	Admittance
1 - 2	2 – j8
1 – 3	1 – j4
2 – 3	0.666 – j2.664
2 – 4	1 – j4
3 – 4	2 – j8

The schedule of active and reactive powers is

Bus code	P	Q	V	Bus Specification
1	-	-	$1.06\angle 0^0$	Slack
2	0.5	0.2	Not specified	PQ
3	0.4	0.3	Not specified	PQ
4	0.3	0.1	Not specified	PQ

Form Y_{bus}, and compute the voltages at buses 2, 3, and 4 at the end of first iteration using Gauss Seidal method. Take acceleration factor, $\alpha = 1.6$.

III. A. The fuel cost functions in Rs./hr. for three thermal plants are given by

$$C_1 = 350 + 7.20P_1 + 0.0040P_1^2$$
$$C_2 = 500 + 7.30P_2 + 0.0025P_2^2$$
$$C_3 = 600 + 6.74P_3 + 0.0030P_3^2$$

where P_1, P_2, and P_3 are in MW. The governors are set such that generators share the load equally. Neglecting line losses and generator limits, determine the optimal scheduling of generation, when the total load is i) 450 MW, and ii) 1335 MW.

OR

B. i) Explain the schematic diagram of load frequency control and automatic voltage regulation of a synchronous generator.

ii) A two area system connected b a tie line has the following parameters on a 1000 MVA common base.

Area	1	2
Speed regulation	0.05	0.0625
Frequency-sens. Load coeff.	0.6	0.9
Inertia constant	5	4
Base power	1000 MVA	1000 MVA
Governor time constant	0.2 secs.	0.3 secs.
Turbine time constant	0.5 secs.	0.6 secs.

The units ae operating in parallel at the nominal frequency of 60 Hz. The synchronizing power coefficient is compared from the initial operating condition and is given to be $P_s = 2$ per unit. A load change of 187.5 MW occurs in area 1. Determine the new stead state frequency and the change in the tie line flow.

IV. A. Derive the necessary equations for calculating the fault current and bus voltages for

i) single line to ground fault

ii) double line to ground fault

OR

B. A generating station having n section busbars each rated at Q kVA with x% reactance is connected on the tie-bars system through busbar reactances of b%. Determine the short circuit kVA when n is very large.

V. A. i) Derive an expression for the maximum power transfer between two nodes. Show that this power is maximum when $X = \sqrt{3}R$, where X is the reactance and R is the resistance of the system.

ii) A motor is receiving 25% of the power that is capable of receiving from an infinite bus. If the load on the motor is doubled, calculate the maximum and minimum value of δ during the swinging of the rotor around its new equilibrium position.

OR

B. Discuss briefly, the different methods of improving voltage stability of power system.