C 18234 (Pages : 4) Name..............................

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SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION

JUNE 2011

EE 04 604—POWER SYSTEMS—II

(2004 Admissions)

Time : Three Hours Maximum : 100 Marks

Answer all *questions.*

Part A

I. (a) Formulate Z_{bus} for the system in Fig. 1.

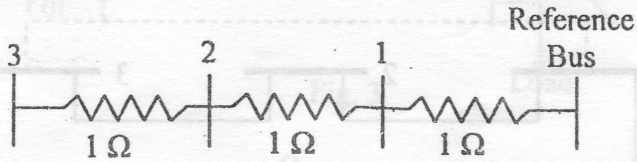

Fig. 1.

(b) Starting from the first principles, develop the equationsfor real and reactive bus powers.

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

$F_1 = 0.2P_1^2 + 40P_1 + 120$ Rs. per hour

$F_2 = 0.25P_2^2 + 30P_2 + 150$ 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 the schematic diagram of load frequency control and automatic voltage regulation of a synchronous generator.

(e) With a general circuit, to determine the zero sequence network of a two winding network, draw the zero sequence networks of

(i) star-star transformer with star point grounded.

(ii) delta-delta transformer.

(f) A 69 kV circuit breaker having a continuous current rating of 12000 A has a rated short circuit current of 19000 A at a maximum rated voltage of 72.5 kV. Determine the maximum symmetrical interrupting capacity of the breaker.

(g) A 2 pole, 50 Hz, 11 kV, turbo alternator has a ratio of 1000 MW, power factor of 0.85 lagging. The rotor has a moment of inertia of 10,000 kg-m^2. Calculate H and M.

(h) Explain why does voltage instability occur in a power system.

(8 × 5 = 40 marks)

Turn over

Part B

II. (a) The line impedances of a four bus system in Fig. 2 are

Line (bus to bus)	1 - 2	2 - 3	3 - 4	1 - 4
R(per unit)	0.025	0.02	0.05	0.04
X (per unit)	0.10	0.08	0.20	0.16

(i) Assume that the line shown dotted (from bus 1 to bus 3) is not present. Formulate Y_{bus}.

(ii) Which element of the Y_{bus} obtained above are effected when the line from bus 1 to bus 3 is added ? If the per unit impedance of this line is $0.1 + j0.4$, find the new Y_{bus}.

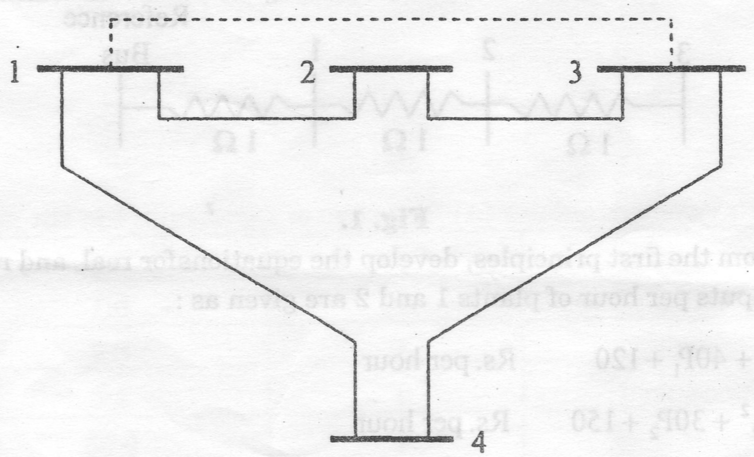

Fig.2

Or

(b) The series impedance and shunt admittance of each line of a three bus system are $0.026 + j0.11$ per unit and $j0.04$ per unit respectively. The bus specification and power input etc., at the buses are

Bus	P_G	Q_G	P_L	Q_L	Bus Voltage
1	Unspecified	Unspecified	1.0	0.5	1.03 L 0° (slack bus)
2	1.5	Unspecified	0	0	V = 1.03 (PV bus)
3	0	0	1.2	0.5	Unspecified (PQ bus)

For bus 2, the minimum and maximum reactive power limits are 0 and 0.8 per unit. Form Y_{bus}. Find P_2^0, Q_2^0, P_3^0, and Q_3^0 using Newton Raphson method.

III. (a) For the two-bus system in Fig. 3, if 100 MW is transmitted from plant 1 to the load, a transmission loss of 10 MW is incurred. Find the required generation for each plant and the power received by load when the system λ is Rs. 25/MWh.

$$\frac{dC_1}{dP_{G1}} = 0.02_{G1} + 16.0 \text{ Rs./MWh}$$

$$\frac{dC_2}{dP_{G2}} = 0.04\, P_{G2} + 20.0 \text{ Rs./MWh}$$

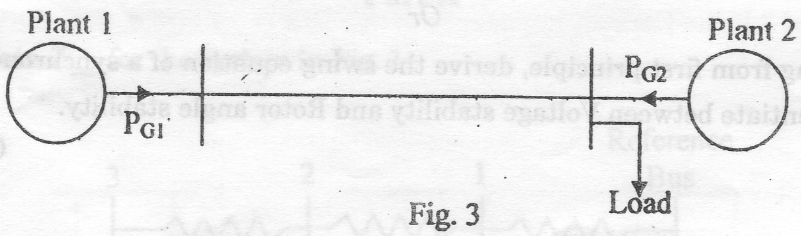

Fig. 3

Or

(b) The automatic voltage regulator (AVR) system of a generator has the following parameters.

Parameters	Gain	Time constant
Amplifier	K_A	0.1
Exciter	1	0.4
Generator	1	1.0
Sensor	1	0.05

(i) Draw the AVR block diagram for the above problem.

(ii) Obtain the transfer function of the AVR system.

IV. (a) The zero-, positive-, and negative-sequence bus impedance matrices for a three bus system are

$$Z^0_{bus} = j\begin{bmatrix} 0.20 & 0.05 & 0.12 \\ 0.05 & 0.10 & 0.08 \\ 0.12 & 0.08 & 0.30 \end{bmatrix} \text{ pu ; and } Z^1_{bus} = Z^2_{bus} = j\begin{bmatrix} 0.16 & 0.10 & 0.15 \\ 0.10 & 0.20 & 0.12 \\ 0.15 & 0.12 & 0.25 \end{bmatrix} \text{ pu}$$

Determine the per unit fault current and the bus voltages during fault for

(i) a bolted single line to ground fault at bus 2.

(ii) a bolted double line to ground fault.

Or

(b) Derive the necessary equations for calculating the fault current and bus voltages for

(i) a three phase fault

(ii) line to line fault.

V. (a) (i) Discuss the factors that affect steady state stability and transient state stability of the system.

(ii) A 50 Hz generator is delivering 50% of the power that it is capable of delivering through a transmission line to an infinite bus. A fault occurs that increases the reactance between the generator and the infinite bus to 500% of the value before the fault. When the fault is isolated, the maximum power that can be delivered is 75% of the original maximum value. Determine the critical clearing angle for the condition described.

Or

(b) (i) Starting from first principle, derive the swing equation of a synchronous machine.

(ii) Differentiate between Voltage stability and Rotor angle stability.

($4 \times 15 = 60$ marks)