Ref. No. :EX/PE/PE/B/T/323B

B. E. POWER ENGG. 3RD YEAR 2ND SEMESTER EXAMINATION 2024

POWER SYSTEM ANALYSIS AND OPERATION

TIME: THREE HOURS **FULL MARKS:100**

1.a) The incremental cost characteristic of the two units in a plant are

$(IC)_1 = 8.0 + 0.1P_1$ Rs/ MWh,

$(IC)_2 = 3.0 + 0.15P_2$ Rs/ MWh,

When the total load is 100 MW, the optimum sharing of load is

(i) 40 and 60 (ii) 33.3 and 66.7 (iii) 60 and 40 (iv) 66.7 and 33.3 5 [CO1]

b) Show that the transmission loss is a function of active power generation of each plant. 15[CO1]

Or

1) Explain the following terms:
(i) Start-up cost (ii) spinning reserve requirement (iii) ramp rate limit constraints (v) valve-point effect (vi) fuel constraints 3+5+5+4+3 [CO1]

2. a) A power system has two synchronous generators. The governor- turbine characteristics corresponding to the generators are

$P_1 = 50(50 - f)$ and $P_2 = 100(51 - f)$

where f denotes the system frequency in Hz, P_1 and P_2 are the power outputs of two generators in MW. Assuming the generators and transmission network to be lossless, the system frequency for a total load of 400MW is

(i) 47.5Hz (ii) 48.0Hz (iii) 48.5Hz (iv) 49.0Hz 5 [CO2]

b) Consider a power system with three identical governors. The transmission losses are negligible. One generator (G1) has a speed governor which maintains its speed constant at the rated value, while other generators (G2 and G3) have governors with a droop of 5%. If the load of the system is increased, then on steady state

(i) generation of G2 and G3 is increased equally while generation of G1 is unchanged.
(ii) generation of G1 alone is increased while generation of G1 is unchanged.
(iii) Generation of G1, G2 and G3 is increased equally.
(iv) Generation of G1, G2 and G3 is increased in the ratio of 0.5:0.25:0.25. 3[CO2]

c) Single control area fitted with proportional plus integral controller is

(i) isochronous and unstable. (ii) isochronous and stable (iii) non0isochronous and unstable
(iv) non-isochronous and stable 2[CO2]

d) What is control area? Discuss the advantages of interconnected operation of power systems. 4+6[CO2]

Or

2. a) Two power systems A and B each having a regulation (R) of 0.05 p.u. on thir respective capacity bases and their stiffness (damping coefficient) of 0.75 p.u. are connected through a tie-line, initially carrying no power. The capacity of system A is 2000MW and that of system B is 3000MW. If there is an increase in load of 200MW in system A, what is the change in power transfer. 14[CO2]

b) What is meant by ITL and penalty factor? 6[CO2]

3. a) Steady state stability of a power system is the ability of the power system to
(i) maintain voltage at the rated voltage level (ii) maintain frequency exactly at 50 Hz
(iii) maintain a spinning reserve margin at all times (iv) maintain synchronism between machines and on external tie lines. 2[CO3]

b) The synchronizing coefficient between two areas of a 2-area power system is
(i) $\frac{\partial P}{\partial |V|}$ (ii) $\frac{\partial P}{\partial \delta}$ (iii) $\frac{\partial P}{\partial f}$ (iv) $\frac{\partial P}{\partial Q}$ 3[CO3]

c) For transient stability analysis, as long as equal area criterion is satisfied, the maximum angle to which rotor angle can oscillate is
(i) 90^{o} (ii) 45^{o} (iii) greater than 90^{o} (iv) less than 90^{o} 3[CO3]

d) Describe different factors that affect power system transient stability. 12[CO3]

Or

3.a) What is critical clearing angle and critical clearing time? 5[CO3]

B) Derive swing equation while an alternator connected to infinite bus bar via an inductive interconnector. 15[CO3]

4. a) Compare the merits and demerits of "Gauss-Seidel" method and "Newton-Raphson" method. 5 [CO4]

b) Consider the three-bus power system shown in Fig. 4. Each of the three lines has a series impedance of 0.026 + j0.11 p.u. and a total shunt admittance of j0.04p.u. The specified quantities at the buses are shown in Table 1. 15 [CO4]

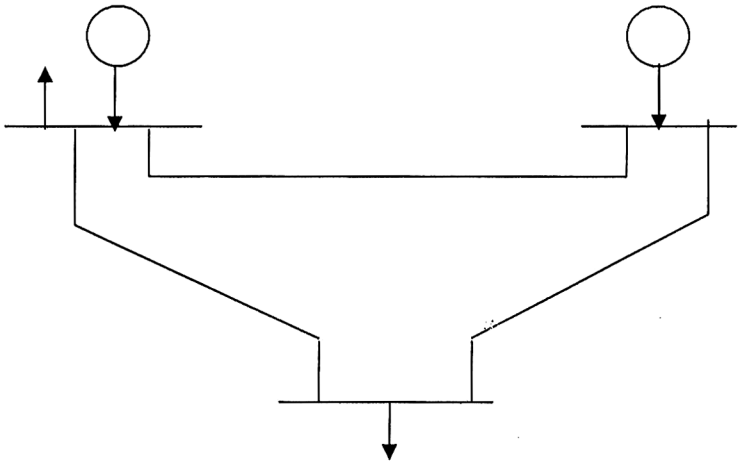

Figure 4

For bus 2 the minimum and maximum reactive power limits are 0 and 0.8 p.u.. Find the load flow solution using Fast Decoupled method.

Table 1

Bus No.	P_G	Q_G	P_D	Q_D	Voltage specification
1	Unspecified	Unspecified	1.0	0.5	$V_1 = 1.02 + j0$ (Slack bus)
2	1.5	Unspecified	0	0	$\|V_2\| = 1.04$ (PV bus)
3	0	0	1.2	0.5	Unspecified (PQ bus)

OR

4. Describe different objectives and constraints of optimal power flow problem. 20[CO4]

5. a) What is load forecasting ? 5 [CO5]

b) Describe short-term and very short-term load forecasting. 15 [CO5]

Or

5. a) Describe the factors that affect load patterns.	10[CO5]
b) Describe different components of electricity load.	7[CO5]
c) What is load duration curve?	3[CO5]