This question paper contains 6 printed pages.

8491 *Your Roll No.* .....

B.Tech. (EEE) / IV **A**

PAPER EEE–403— POWER SYSTEM – II

Time : 3 hours *Maximum Marks* : 70

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt five questions in all. Question No. 1 is compulsory.

All questions carry equal marks.

1. Indicate whether the following statements are 'True' or 'False'. Justify your answer.

(*i*) A voltage-controlled bus is treated as a load bus in subsequent iteration when its reactive power limit is violated.

(*ii*) In a two plant system, the load is connected at plant no. 2. The loss coefficients B_{11} and B_{22} are non-zero but B_{12} is zero.

(*iii*) A power plant has a maximum demand of 15 MW. The load factor is 50% and the plant factor is 40%. The operating reserve is 3·75 MW.

(*iv*) The cost function of a 50 MW generator is given by (P_i is the generator loading)

$$F(P_i)=225+53P_i+0\cdot02P_i^2.$$

P. T. O.

When 100% loading is applied, the incremental fuel cost (IFC) will be Rs. 55 per MW.

(*v*) Ring main distribution is preferred to a radial system because voltage drop in the feeder is less and supply is more reliable.

(*vi*) In load-flow analysis, the load at a bus is represented as a constant current drawn from the bus.

(*vii*) Interconnected operation of power systems results in less reserve capacity requirement and more reliability. 2×7=14

2. (*a*) Develop the load flow equations suitable for solution by (*i*) Gauss-Seidel method, (*ii*) Newton-Raphson method, using nodal admittance approach. 7

(*b*) Explain with a flow chart the computational procedure for load flow solution using NR method when the system contains all types of buses. 7

3. The load flow data for the sample power system is given below. The voltage magnitude at bus 2 is to be maintained at 1·04 pu. The maximum and minimum reactive power limits of the generator at bus 2 are 0·25 and 0·0 p.u. respectively. Determine the set of load flow equations at the end of first iteration by using NR method. 14

Impedance for the sample system

Bus code	*Impedance*
1–2	$0{\cdot}08+j0{\cdot}24$
1–3	$0{\cdot}02+j0{\cdot}06$
2–3	$0{\cdot}06+j0{\cdot}18$

Schedule of generation and loads

Bus Code	*Assumed voltages*	*Generation*		*Load*	
		MW	*MVAR*	*MW*	*MVAR*
1	$1{\cdot}06+j0{\cdot}0$	0	0	0	0
2	$1{\cdot}0+j0{\cdot}0$	0·2	0·0	0	0
3	$1{\cdot}0+j0{\cdot}0$	0	0	0·6	0·25

4. Fig. 1 shows the single line diagram of a simple four bus system.

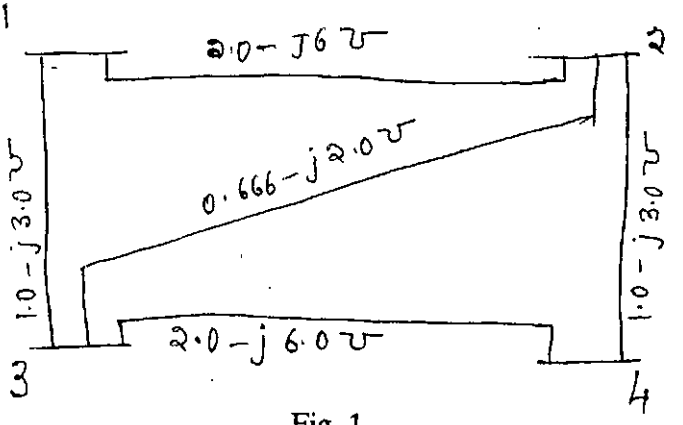

Fig. 1

The p.u. admittances are shown in the diagram.

P. T. O.

(*i*) Draw the linear graph, tree and co-tree of the above circuit. 6

(*ii*) Obtain the bus incidence matrix A and the primitive admittance matrix for the system. 4

(*iii*) Determine the bus admittance matrix using singular transformation. 4

5. (*a*) What is 'Economic Load Dispatch'? What is the need for considering transmission losses while obtaining the economic operating schedule? 4

(*b*) Derive the necessary equations to obtain the ELD including transmission losses. 4

(*c*) A two-bus system is shown in Fig. 2. If a load of 150 MW is transmitted from plant 1 to the load, a loss of 22·5 MW is incurred. Determine the generation schedule and the load demand if the cost of received power is Rs. 24/MWhr. The ICP of the plants are:

$$\frac{dF_1}{dP_1} = 0 \cdot 045P_1 + 15$$

$$\frac{dF_1}{dP_2} = 0 \cdot 06P_2 + 22$$

6

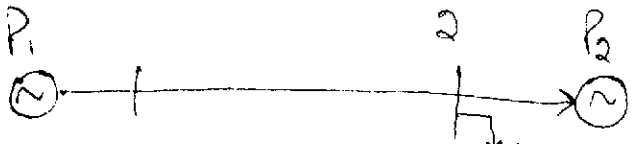

Fig. 2

6. (*a*) Explain the solution of coordination equation with a flow chart. 7

(*b*) Incremental fuel costs in \$/MWhr for a plant consisting of two units are:

$$\frac{dF_1}{dP_1}=0\cdot20P_1+40\cdot0$$

$$\frac{dF_2}{dP_2}=0\cdot25P_2+30\cdot0$$

The total load varies from 40 MW to 250 MW, and the maximum and minimum loads on each unit are to be 125 and 20 MW, respectively. How will the load be shared between the two units as the system load varies over the full range? 7

7. A generating station has a maximum demand of 15 MW and the daily load on the station is as follows:

10 pm to 5 am – 2500 kW

5 am to 7 am – 3000 kW

7 am to 11 am – 9000 kW

11 am to 1 pm – 6000 kW

1 pm to 4 pm – 10,000 kW

4 pm to 6 pm – 12,000 kW

6 pm to 8 pm – 15,000 kW.

8 pm to 10 pm – 5,000 kW.

P. T. O.

(b) Draw load curve, load duration curve and integrated load duration curve. 7

(c) Determine the size and number of generating units, plant load factor, plant capacity factor, use factor and reserve capacity of the plant. 7

8. (a) What is meant by Base Load and Peak Load plants? For a maximum demand of P, determine the economic loading of base load and peak load stations. 7

(b) A system has a straight line and annual load duration curve with maximum and minimum demands of 20 MW and 5 MW respectively. The annual cost characteristics of base load and peak load stations are respectively given by:

C_1 = Rs. 10,00,00+ Rs. 100/kW+6 P/kWhr

C_2 = Rs. 80,000+Rs. 60/kW+8 P/kWhr. 7

Determine the operating schedule of peak load station for minimum annual cost. Hence, determine the overall cost per kWhr. 7