This question paper contains 6 printed pages.

3301 *Your Roll No.* .....

B.Tech. (EEE) / IV J

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. Give reasons for the following statements:

   (*i*) An acceleration factor is commonly used in load-flow studies in power systems using G-S method.

   (*ii*) The production cost is considered as a function of real-power generation.

   (*iii*) In order to have lower cost of electrical energy generation, the load factor and diversity factor should be high.

   (*iv*) Straight line method of raising depreciation fund gives heavier charges in the initial years of plant life.

P. T. O.

(*v*) The diagonal elements of a nodal admittance matrix are strengthened by adding shunt inductances.

(*vi*) Run-off river plants with pondage, small capacity thermal power stations or diesel stations are normally used as peak load stations.

(*vii*) $\frac{X}{k}$ ratio for distribution lines is greater than 1. 14

2. (*a*) What are the various types of buses in a Power System for load flow studies? Why is one of the generator buses designated as slack bus? 7

(*b*) What are the assumptions under decoupled load flow method? Explain the stepwise procedure of Fast Decoupled Load Flow method. 7

3. A generating station has a maximum demand of 10,000 kW and a daily load on the station is as follows:

Time	*kW*	*Time*	*kW*
11 PM to 6 AM	2000	1 PM to 5 PM	7500
6 AM to 8 AM	3500	5 PM to 7 PM	8,500
8 AM to 12 noon	8000	7 PM to 9 PM	10,000
12 Noon to 1 PM	3000	9 PM to 11 PM	4,500

(*a*) Draw chronological load curve, load duration curve and integrated load duration curve. 9

(*b*) Choose the size and number of generating units. What reserve plant would be necessary? Find the load factor and plant capacity factor. 5

4. (*a*) Explain why it is necessary to develop non-conventional methods of generating electrical energy. 5

(*b*) A region has a maximum demand of 600 MW at a load factor of 60%. The load-duration curve can be assumed to be a triangle. The utility has to meet this load by setting up a generating system which is partly hydro and partly thermal. The costs are as under:

Hydro plant : Rs. 6000 per kW per annum and operating expenses of 30 paise/kWh. 9

Thermal plant: Rs. 4000 per kW per annum and operating expenses of Rs. 1·50 per kWh.

Determine the capacity of hydro plant, energy generated annually by each and overall generation cost per kWh.

5. (*a*) Explain with a flow chart the computational procedure for LF solution for a system having P-Q buses only using NR method. How does the method get modified when PV buses are also present? 7

P. T. O.

(*b*) Explain the formulation of Y-matrix (admittance matrix) of a power system. What are the advantages of using this matrix for load flow analysis? 4

(*c*) How is the admittance matrix changed when on-load tap changing transformer is introduced in a line connected between two buses? 3

6. (*a*) What is economic load dispatch? Explain it for thermal plants co-ordinating the system transmission line losses. Derive the relevant equations and state the significance and role of penalty factor. 7

(*b*) A system consists of two generating plants with fuel costs of:

$$F_1 = 0 \cdot 05P_1^2 + 20P_1 + 1 \cdot 5$$

$$F_2 = 0\ 075P_2^2 + 22 \cdot 5P_2 + 1 \cdot 6$$

The system operates on economic dispatch with 100 MW of power generation by each plant. The incremental transmission loss (ITL) of plant 2 is 0·2. Find the penalty factor of plant 1. 7

7. The load flow data for a four-bus system are given in Table I and II. The voltage magnitude at bus 2 is to be maintained at 1·04 pu. The maximum and minimum reactive power limits for bus 2 are 0·2 and 1 pu respectively. Taking bus 1 as the slack bus, determine

the voltages of various buses at the end of first iteration starting with a flat voltage profile for all buses except slack bus using G-S method.

Table – I

Admittance for the system

Line	*G (pu)*	*B (pu)*
1–2	2·0	–6·0
1–3	1·0	–3·0
2–3	0·666	–2·0
2–4	1·0	–3·0
3–4	2·0	–6·0

Table – II

Input Data

Bus code	*P*	*Q*	*V*	*Remarks*
1	–	–	1·04	Slack
2	0·5	0·2	1·0+*j*0·0	PV bus
3	1·0	0·5	1·0+*j*0·0	PQ bus
4	0·3	–0·1	1·0+*j*0·0	PQ bus

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8. (*a*) Derive the transmission loss formula and state the assumptions made in it. 7

(*b*) A system consists of two plants connected by a tie line and a load is located at plant 2. When 100 MW are transmitted from plant 1, a loss of 8 MW takes place on tie-line. Determine the generation

schedule for both the plants and the power received by the load when λ for the system is Rs. 100/MWh. The incremental costs of the two plants are given by:

$$\frac{dF_1}{dP_1}=0\cdot 12P_1+65 \text{ Rs./MWhr.}$$

$$\frac{dF_2}{dP_2}=0\cdot 25P_2+75 \text{ Rs./MWhr.} \quad 7$$