(Set-L)

B.Tech-7th

Power System Operation and Control

Full Marks : 70

Time : 3 hours

Q.No.1 is compulsory and answer any **five** questions from the rest

The figures in the right-hand margin indicate marks

1. Answer the following questions : 2 × 10

   (*a*) The p.u. impedance value of an alternator corresponding to base values 13·2 kV and 30 MVA is 0·2 p.u. Calculate the p.u. value for base values of 13·8 kV and 50 MVA.

   (*b*) Write down the different types of buses specified for load flow study.

   (*c*) How the bus admittance matrix is assemble ?

(*d*) The voltage at the two ends of a line are 132 kV and its reactance is 40 ohms. Calculate the capacity of the line.

(*e*) Justify what is the necessity of selecting one of the buses as slack bus.

(*f*) A power system network consists of three elements 0-1, 1-2 and 2-0 of per unit impedances 0·2, 0·4 and 0·4 respectively. Calculate the bus admittance matrix.

(*g*) Explain the terms Incremental fuel rate and Incremental efficiency.

(*h*) If the penalty factor for bus 1 in a two-bus system is 1·25 and if the incremental cost of production at bus 1 is Rs. 200 per MWhr, then calculate the cost of received power at bus 2.

(*i*) What is the boundary conditions for a double line to ground fault which takes place on phase's *b* and *c* ? Also draw the sequence network for L-L-G fault.

(*j*) What are the different parts of a speed governing system ?

2. (*a*) What is load flow solution ? Explain its significance in power system analysis. 5

(*b*) Two generators rated at 10 MVA, 13·2 kV and 15 MVA, 13·2 kV are connected in parallel to a bus bar. They feed supply to two motors of inputs 8 MVA and 12 MVA respectively. The operating voltage of motors is 12·5 kV. Assuming base quantities as 50 MVA and 13·8 kV draw the reactance diagram. The percentage reactance for generators is 15 % and that for motors is 20%. 5

3. (*a*) Write and explain the Swing equation and its solution methods. 5

(*b*) A synchronous machine connected to an infinite bus through a transmission line. The maximum power transfer of this system is 5·0 pu and immediately prior to the instant of fault the power transfer is 2·5 pu. Peak values of power angle curve during fault and post fault conditions are 2·0 pu and 4·0 pu respectively. Find out the critical clearing angle . 5

4. (*a*) Write the various system constraints in the Economic load dispatch problems. 5

(*b*) Incremental fuel costs in Rs. Per megawatt hour for two units in a plant are given by

$$\frac{dF_1}{dP_1} = 0{\cdot}1P_1 + 20\,; \quad \frac{dF_2}{dP_2} = 0{\cdot}12P_2 + 16$$

The minimum and maximum loads on each unit are to be 20 MW and 125 MW respectively. Determine the incremental fuel cost and the allocation of load between units for minimum cost when loads are (*i*) 100 MW ; (*ii*) 150 MW. Assume both the units are operating. 5

5. (*a*) Explain the concept of power system voltage stability and give definitions of voltage stability. 5

(*b*) An inter-connection with inductive reactance of 25Ω and negligible resistance has two units of generations with voltages of 33 kV and 30 kV at its ends. A load of 6 MW is to be transferred from 33 kV to 30 kV side of interconnector. Determine the power factor of the power transmitted and other necessary conditions between the two ends. 5

6. (*a*) Derive and explain optimum load dispatch criterion including transmission losses. 5

(*b*) A 210 MVA, 50 Hz turbo alternator operates at no-load at 3000 rpm. A load of 75 MW is suddenly applied to the machine and the steam valves to the turbine commence to open after 1 sec due to time lag in the governor system. Assuming inertia constant H of 5 kW-sec per kVA of generator capacity, calculate the frequency to which the generated voltage drops before the steam flow commences to increase to meet the new load. 5

7. (*a*) Explain the p.u. system of analyzing power system problems. Discuss the advantages of this method analysis. 5

(*b*) A 440 V 3-phase supply is connected to three star-connected loads in parallel

through a feeder of impedance $(0{\cdot}1 + j0{\cdot}5)\Omega$ per phase. The loads are as follows : 5 kW, 4 kVAr; 3 kW, 0 kVAr & 10 kW, 2 kVAr. Determine : (*i*) Line current ; (*ii*) Power and reactive power losses in the feeder per phase ; (*iii*) Power and reactive power from the supply and supply power factor. 5

8. Write short notes on any *four* : $2\frac{1}{2} \times 4$

(*i*). On-load tap changing transformer

(*ii*) Factors affecting transient stability

(*iii*) Fast decoupled load flow

(*iv*) Reasons for limits on frequency

(*v*) The Equal Area Criterion of stability.
