Code No. : 5097

FACULTY OF ENGINEERING

B.E. 4/4 (E & EE) I Semester (Main) Examination, December 2011

POWER SYSTEM OPERATION AND CONTROL

Time : 3 Hours] [Max. Marks : 75

***Note** : Answer **all** questions from Part **A**, answer **any five** questions from Part **B**.*

PART – A **(25 Marks)**

1. In the load flow problem, why only two quantities are specified at each bus ? **2**

2. If converged load flow solution is available, how do you determine slack bus, complex bus power injection and the system total loss ? **3**

3. The incremental fuel costs in Rs/MWh for a thermal plant consisting of two units are given by

$$\frac{dF_1}{dP_1} = 0.008\,P_1 + 8.0 \text{ Rs/MWh} ; 100 \le P_1 \le 650 \text{ MW}.$$

$$\frac{dF_2}{dP_2} = 0.0095\,P_2 + 6.0 \text{ Rs/MWh} ; 100 \le P_2 \le 650 \text{ MW}.$$

Determine the P_o value at which both the units start sharing the load economically. **3**

4. Distinguish between incremental fuel rate and heat rate. **2**

5. The governor characteristics of two turbo alternators rated at 150 MW and 200 MW are 5% and 4% respectively. Calculate P_1 and P_2 when the machines are in parallel and sharing a common load of 160 MW. **3**

6. Mention the advantages of pool operation of a power system ? **2**

7. A 100 MVA synchronous generator operates on full load at a frequency of 50 Hz. The load is suddenly reduced to 50 MW. Due to time lag in governor system, the steam valve begins to close after 0.5 sec. Determine the change in frequency that occurs in this time ? Given H = 5 kW-sec/kVA. **3**

8. List out the assumptions made in transient stability analysis. **2**

9. Explain how the voltage is related to reactive power ? **2**

10. Draw and explain the operation of TCSC ? **3**

PART – B (50 Marks)

11. a) Explain the Newton-Raphson method of load flow studies using Y_{BUS} with the help of a flow chart. Compare this method with the decoupled load flow method ? 6

b) Obtain the Y_{BUS} of the network shown in Fig. 1. Use the base values of 220 kV and 100 MVA and express all impedances and admittances in P.u. If the lines are characterized by series impedance of $(0.1 + j0.7)\ \Omega$/km and shunt admittance of $(j0.35\times10^{-5})\ \mho$/km. 4

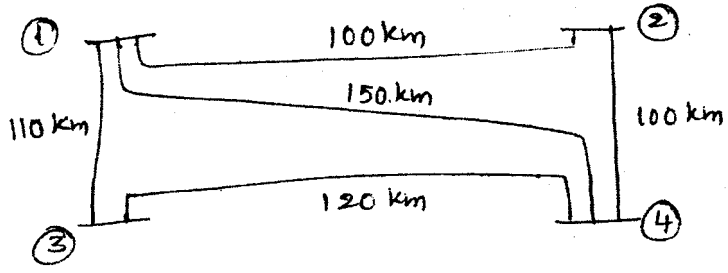
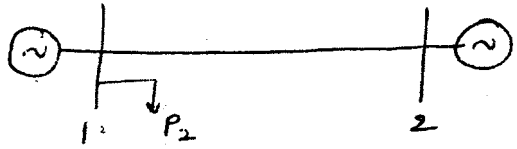


Fig. 1

12. a) Derive an expression for B_{mn} coefficient. State the assumptions made. 5

b) In the system shown in fig. 2, a transmission loss of 10 MW takes place when 100 MW of power is transmitted over the line. Find the required generation at each plant and power received by the load when $\lambda = 25$ Rs/MWhr. The incremental fuel costs of the plants are

$$\frac{dF_1}{dP_1} = 0.02P_1 + 16 \text{ Rs/MWhr}\,;\frac{dF_2}{dP_2} = 0.03P_2 + 20 \text{ Rs/MWhr}$$



5

Fig. 2

13. Explain the concept of control area. Develop the state-space representation of two area control system. 10

14. a) Discuss the procedure for solving the swing equation by step-by-step method. 5

    b) A generator operating at 50 Hz delivers 1 P.u. power to an infinite bus through a transmission circuit in which the resistance is ignored. A fault takes place reducing the maximum power transferable to 0.5 Pu. Whereas before the fault, this power was 2.0 and after clearance of the fault, it is 1.5 Pu. By use of equal area criterion, determine the critical clearing angle. 5

15. a) Explain the significance of automatic voltage regulator on reactive power generation of synchronous machine. 5

    b) Discuss with a neat sketch the operation of STATCOM ? 5

16. a) Develop the mathematical formulation of voltage stability problem ? 5

    b) Two power stations A and B are located close together. Station A has four identical generator sets each rated 100 MVA and each having an inertia constant of 9 MJ/MVA where as station B having an inertia constant of 9 MJ/MVA whereas station B has three sets each rated 200 MVA, 4 MJ/MVA. Calculate the inertia constant of the equivalent machines of both the stations on 150 MVA base. 5

17. Write short notes on the following :

    a) Factors affecting transient stability 3

    b) Regulation of two alternators in parallel 4

    c) Effect of Q-adjustments on rate of convergence of NR and FDC load flow methods. 3