Ref. No. : Ref. No. : Ex/PE/T/424D/2019

B. E. POWER ENGG. 4TH YEAR 2ND SEMESTER EXAMINATION, 2019

# COMPUTER AIDED POWER SYSTEM ANALYSIS AND OPERATION

TIME: THREE HOURS FULL MARKS: 100

1. a) What is load forecasting? 4
b) Describe short-term load forecasting and long-term load forecasting. 16

2. Explain the following terms:
(i) must run unit (ii) minimum up time and minimum down time (iii) transitional cost
(iv) ramp rate limit (iv) valve-point effect 3+5+4+5+3

OR

For a two-generator system, fuel costs of the plants are given below:

$F_1 = 200 + 10.333P_{G1} + 0.00889P_{G1}^2$ Rs/h, $10MW \le P_{G1} \le 150MW$

$F_2 = 240 + 10.833P_{G2} + 0.0074P_{G2}^2$ Rs/h, $15MW \le P_{G1} \le 100MW$

The transmission loss is given by $P_L = 0.001P_{G1}^2 + 0.0025P_{G2}^2$
Determine the economic schedule to meet 200 MW demand and the corresponding cost of generation. 20

3. a) Describe the advantages of interconnected operation of power systems. 8
b) Two thermal generating units are operating in parallel at 60 Hz to supply a total load of 700 MW. Unit 1, with a rated output of 600 MW and 4% speed droop characteristic, supplies 400 MW and unit 2, which has a rated output of 500 MW and 5% speed droop, supplies the remaining 300 MW of load. If the total load increases to 800 MW, determine the new loading of each unit and the common frequency change before any supplementary control action occurs. 12

OR

Show the block diagram of Two-area Load Frequency control of power system with single tie-lines connecting them. Assume each area being provided with P-I controllers. Derive necessary equations and explain the different parameters of control. 20

4. a) Describe various factors that affect power system transient stability. 6

b) Explain the equal- area criterion for stability of an alternator supplying infinite bus bar via an inductive interconnector. Mention the limitations of the method. 14

OR

A 60 Hz synchronous generator having inertia constant H = 5 MJ/MVA and a direct axis transient reactance $X_d' = 0.3$ p.u. is connected to an infinite bus through a purely reactive circuit shown in Fig. 4. Reactances are marked on the diagram on a common system base. The generator is delivering real power P = 0.8 p.u. and lagging reactive power Q = 0.074 p.u. to the infinite bus at a voltage of V = 1 p.u..

A three-phase fault occurs at the middle of one of the lines, the fault is cleared and the fault line is isolated. Determine the critical clearing angle and the critical fault clearing time. 20

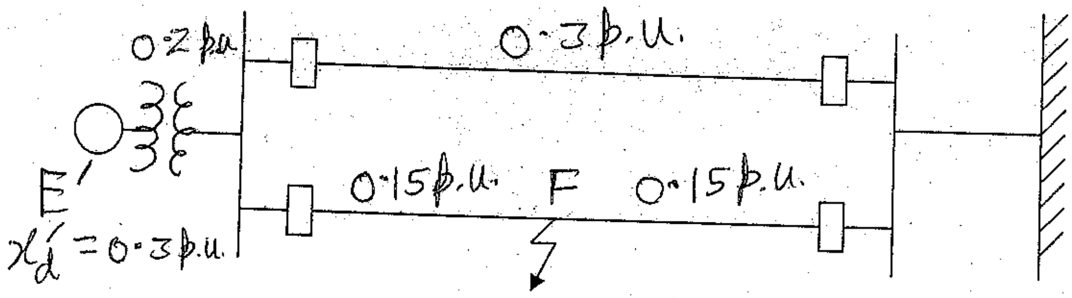


Fig. 4

5. a) What is optimal load flow? Explain its significance in power system. 8

b) Consider the three-bus system shown in Fig. 5. Each of the three lines has a series impedance of 0.025 + j0.075 p.u. and a total shunt admittance of j0.02 p.u.

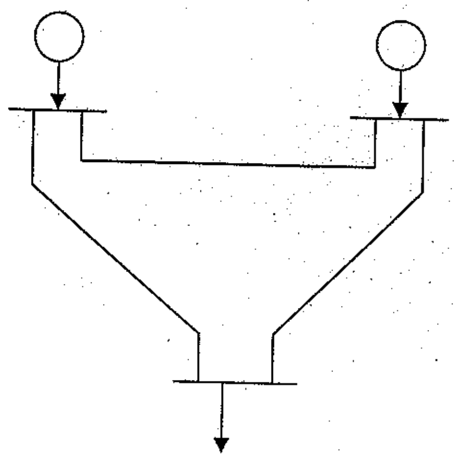

Fig. 5

The specified quantities at the buses are given in Table 1. Controllable reactive power source is available at bus 3 with the constraint $0 \le Q_{G3} \le 1.2$ p.u. Use Fast Decoupled method to obtain one iteration of the load flow solution. 12

Table 1

| Bus. No. | $P_G$ | $Q_G$ | $P_D$ | $Q_D$ | Voltage specification |
|---|---|---|---|---|---|
| 1 | Unspecified | Unspecified | 2.0 | 1.0 | $V_1 = 1.1 + j0$ |
| 2 | 0.5 | 1.0 | 0 | 0 | Unspecified |
| 3 | 0 | $Q_{G3} = ?$ | 1.5 | 0.6 | $\lvert V_3 \rvert = 1.04$ |

OR

Explain clearly with a flow chart the computational procedure for load flow solution using Newton Raphson method when the system contains all types of buses. 20