

POWER SYSTEM ANALYSIS

Full Marks: 70

Time: 3 hours

Answer **six** questions including **Q. No. 1** which is compulsory*The figures in the right-hand margin indicate marks*

1. Answer the following:

2 x 10 = 20

- What is the need for slack bus in a power system? Explain.
- Why do you use a single-line diagram for power system representation? What are the assumptions that are being made while drawing a single-line diagram?
- Explain various applications of state estimations in a power system.
- What are the advantages of pumped storage units?
- Explain about state estimation by orthogonal decomposition.
- Explain the approximations made in simulating contingencies in power systems.
- Two generators rated 200 MW and 400 MW are operating in parallel. The droop characteristics of their governors are 2% and 3% from no load to full load. If the nominal frequency is 50 Hz at no load, how would a load of 600 MW be shared between them? What is the system frequency?
- What is the cost function for unit commitment? Explain.
- Write the advantages of operation of hydrothermal combinations.
- What do you mean spinning reserve?

2. (a) Distinguish between Decoupled method and fast decoupled method of load flow methods. **3**

(b) Determine the bus voltages at the end of first iteration by using following data. Take

bus 1 as slack bus. Use N R method.

7

$$Y_{bus} = \begin{bmatrix} 3-j5 & -1.2+j6 & -1.5+j6 \\ -1.2+j6 & 4-j12 & -3+j6 \\ -1.5+j6 & -3+j6 & 5-j6 \end{bmatrix}$$

Bus	Generation		Load		Bus voltage (p.u.)
	MW	MVar	MW	MVar	
1	0	0	0	0	1.04+j0.0
2	0	0	200	125	1.2+j0.0
3	100	70	50	20	1.0+j0.0

3. (a) With a neat diagram explain briefly different parts of turbine speed governing system? **5**(b) Two control areas have the following characteristics: **5**Area 1: $R_1 = 0.011$ p.u, $B_1 = 0.85$ p.u, base MVA=1000Area 2: $R_2 = 0.018$ p.u, $B_2 = 0.95$ p.u, base MVA=1000

4. (a) What are the advantages of per unit system? 4

(b) A 30 MVA, 13.8 KV, 3-phase generator has a sub transient reactance of 15%. The generator supplies 2 motors through a step-up transformer - transmission line - step down transformer arrangement. The motors have rated inputs of 20 MVA and 10 MVA at 12.8 KV with 20% sub transient reactance each. The 3-phase transformers are rated at 35MVA, 13.2 KV-Δ/115KV-Y with 10 % leakage reactance. The line reactance is 80 ohms. Draw the equivalent per unit reactance diagram by selecting the generator ratings as base values in the generator circuit. 6

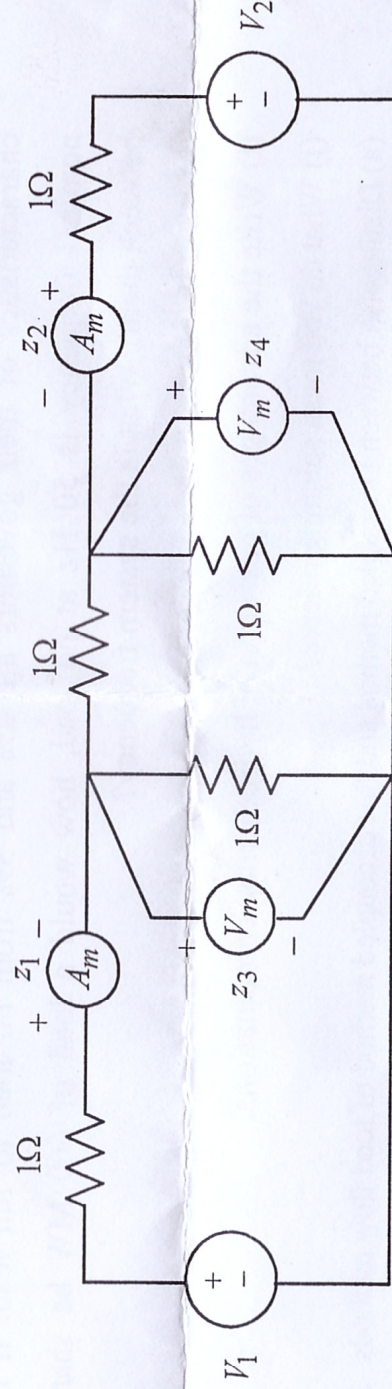
5. (a) What are the applications of the optimal power flow and what are the different solutions of optimal power flow. 5

(b) Explain briefly about newton method optimal power flow. 5

6. (a) Explain the short term and long term hydrothermal economic load scheduling problems. 5

(b) Briefly explain pumped storage scheduling by Gradient method. 5

7. In the circuit shown in Fig. the meter readings are $z_1 = 9.01$ A, $z_2 = 3.02$ A, $z_3 = 6.98$ V and $z_4 = 5.01$ V. Assuming that the ammeters are more accurate than voltmeters and the measurement weights $w_1 = 100$, $w_2 = 100$, $w_3 = 50$ and $w_4 = 50$ respectively. Determine, the weighted least square estimates of the voltages V_1 and V_2 . 10



8. Write a short note on (any two) 5+5

(a) Generation Rate Constraint

(b) Bus admittance matrix

(c) Unit commitment problem