Reg. No. | | | | | | | | | | | | | |

**Question Paper Code : X10407**

**B.E./B.Tech. DEGREE EXAMINATIONS – NOV / DEC 2020**

**Seventh Semester**

Electrical and Electronics Engineering

**EE8702 POWER SYSTEM OPERATION AND CONTROL**

(Regulations 2017)

Time: 3 Hours Answer ALL Questions Max. Marks: 100

**PART- A (10 x 2 = 20 Marks)**

1. Why the frequency and voltage are to be regulated in power system?
2. What happens to frequency if the load on the generator increases?
3. What is the purpose of secondary ALFC?
4. Write the tie line power deviation equation in terms of frequency.
5. What is booster transformer? Where it is used?
6. Compare series and shunt capacitors.
7. What are cold reserves and hot reserves?
8. What are all the points to be noted for an economic load dispatch including transmission losses?
9. Draw the block diagram of PMU with details.
10. What are the different operating states of a power system?

**PART- B (5 x 13 = 65 Marks)**

11. a) Explain the basic P-f and Q-V control loops in power system with relevant block diagram. (13)

**OR**

b) A generation station of 1MW supplied a region which has the following demands:

| From | To | Demand (kW) |
|---|---|---|
| midnight | 5 am | 100 |
| 5 am | 6 pm | No-load |
| 6 pm | 7 pm | 800 |
| 7 pm | 9 pm | 900 |
| 9 pm | midnight | 400 |

Neglect transmission line losses and find the following: i) Plot the daily load curve and the load duration curve. ii) Find the load factor, the reserve capacity, plant capacity factor, plant use factor, the hours that the plant has been off and utilization factor. (13)

12. a) Derive the transfer function of an uncontrolled load frequency control of a single area system and derive the expression for static error following a step load change. (13)

**OR**

b) A two-area power system connected by a tie-line has the following parameters:

| Parameters/Area | Area 1 | Area 2 |
|---|---|---|
| Turbine output Power (MW) | 4000 | 2000 |
| Nominal Frequency (Hz) | 50 | 50 |
| Speed regulation | 4% | 5% |
| Power system Gain ( kp) | 50 | 125 |
| Governor Time Constant | 0.2 | 0.1 |
| Turbine Time Constant | 0.3 | 0.25 |

A load change of 80 MW occurs in area 1. Determine the steady state frequency and the change in the tie-line flow. (13)

13. a) The load at receiving end of a 3phase overhead line is 30 MW, 0.8 pf lag at the line voltage of 66kV. A synchronous compensator is situated at sending end and the voltage at both ends of the line is maintained at 66kV. Calculate the MVAR of compensator. The line has a resistance and reactance of 6Ω/ph, 24 Ω/ph, respectively. (13)

**OR**

b) Two sub-station are connected by two lines in parallel with negligible impedance, but each containing a tap-changing transformer of reactance 0.22pu on the basis of its rating of 200 MVA. Find the net absorption of reactive power when the transformer taps are set to 1:1.08, and 1:0.95 respectively. Assume pu voltages to be equal at the two ends. (13)

14. a) A power plant has two units with the following cost characteristics:

$C_1 = 0.6\ P_1^{\ 2} + 200\ P_1 + 2000$ Rs / hour

$C_2 = 1.2\ P_2^{\ 2} + 150\ P_2 + 2500$ Rs / hour

where $P_1$ and $P_2$ are the generating powers in MW. The daily load cycle is as follows:

6:00 A.M. to 6:00 P.M. 150 MW

6:00 P.M. to 6:00 A.M. 50 MW

The cost of taking either unit off the line and returning to service after 12 hours is Rs 5000. Considering 24 hour period from 6:00 A.M. one morning to 6:00 A.M. the next morning. i) Compute the economic schedule for the peak load and off peak load conditions, ii) Calculate the optimum operating cost per day. (13)

**OR**

b) Consider the following three units:

$IC_1 = 7.92 + 0.003124\ P_{G1}$

$IC2 = 7.85 + 0.00388\ P_{G2}$

$IC3 = 7.97 + 0.00964\ P_{G3}$;

$P_D = 850$ MW ; $P_{G1} = 392.2$ MW; $P_{G2} = 334.6$ MW; $P_{G3} = 122.2$ MW.

Determine the optimum schedule if the load is increased to 900 MW by using Participation Factor method. (13)

15. a) With the help of flowchart explain briefly how the system states are continuously monitored and controlled. (13)

**OR**

b) Explain the hardware components and functional aspects of SCADA system using a fundamental block diagram. (13)

## PART- C (1 x 15 = 15 Marks)

16. a) There are three thermal generating units which can be committed to take the system load. The fuel cost data and generation operating unit data are given below:

$F_1 = 392.7 + 5.544\ P_1 + 0.001093\ P_1^2$

$F_2 = 217 + 5.495\ P_2 + 0.001358\ P_2^2$

$F_3 = 65.5 + 6.695\ P_3 + 0.004049\ P_3^2$

$P_1, P_2, P_3$ in MW Generation limits:

$150 \le P_1 \le 600$ MW;

$100 \le P_2 \le 400$ MW;

$50 \le P_3 \le 200$ MW

There are no other constraints on system operation. Obtain an optimum unit commitment table. Adopt Brute force enumeration technique. Show the details of economic schedule and the component and total costs of operation for each feasible combination of units for the load level of 900 MW.

(15)

**OR**

b) The fuel input data for a three plant system are:

$f_1 = 0.01\ P_1{}^2 + 1.7\ P_1 + 300$ Millions of BTU / hour

$f_2 = 0.02\ P_2{}^2 + 2.4\ P_2 + 400$ Millions of BTU / hour

$f_3 = 0.02\ P_3{}^2 + 1.125\ P_3 + 275$ Millions of BTU / hour

where Pi's are the generation powers in MW. The fuel cost of the plants are Rs 50, Rs 30 and Rs 40 per Million of BTU for the plants 1,2 and 3 respectively. The loss coefficient matrix expressed in $MW^{-1}$ is given by

$$\mathbf{B} = \begin{bmatrix} 0.005 & -0.0005 & -0.001 \\ -0.0005 & 0.01 & -0.0015 \\ -0.001 & -0.0015 & 0.0125 \end{bmatrix}$$

The load on the system is 60 MW. Compute the power dispatch for $\lambda = 120$ Rs / MWh. Calculate the transmission loss. Also determine the power dispatch with the revised value of $\lambda$ taking 10 % change in its value. Estimate the next new value of $\lambda$.

(15)

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