CBCS SCHEME

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21EE72

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Power System Operation and Control

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. List out the operating states of power system. Explain it briefly with a neat block diagram. **(08 Marks)**

b. List out the seven key concepts proposed by North American Electric Reliability Corporation (NERC). Explain any two in brief. **(07 Marks)**

c. List out the four major components of Energy Centres. Explain any two in brief. **(05 Marks)**

OR

2 a. What are Intelligent Electronic Devices (IED's)? Explain IED functional block diagram in detail. **(08 Marks)**

b. List out the objectives of power system control. Discuss the measures taken to achieve them. **(07 Marks)**

c. Draw the following standard SCADA configurations:
(i) Single Master Station and Single Remote Terminal Unit (RTU)
(ii) Single Master Station and Multiple RTU's
(iii) Multiple RTU's, multi-drop circuit, multiple masters
(iv) Multiple master stations, multiple single ported RTU's
(v) Single Master Station, multiple sub-master stations **(05 Marks)**

Module-2

3 a. Draw a neat schematic diagram of load frequency and excitation voltage regulation of a turbo generator. Explain its operation in detail. **(08 Marks)**

b. With a derivation of transfer function of an isolated power system equipped with PI controller (proportional + Integral), prove that steady state frequency error results zero for a step change in the load. **(12 Marks)**

OR

4 a. Draw a neat schematic diagram of turbine speed governing system. Explain all the components of it in detail. **(08 Marks)**

b. Derive mathematical model of the following components only:
(i) Turbine model (ii) Generator + Load model **(12 Marks)**

Module-3

5 a. With a neat schematic diagram of alternator voltage regulator scheme, explain Automatic Voltage Control (AVR) with necessary mathematical equations and transfer functions. **(10 Marks)**

b. Write a short note on load frequency control with generation rate constraints (GRC's). **(05 Marks)**

c. 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 0.4 sec. Determine the change in frequency that occurs in this time. Take H = 5 KWs/KVA. **(05 Marks)**

OR

6 a. Derive the mathematical model of Tie line. And draw complete block diagram of two area system with primary loop only. **(10 Marks)**

b. Write a short note speed governor dead band and its effects on Automatic Generation Control (AGC). **(05 Marks)**

c. Two generators rated 200 MW and 400 MW are operating in parallel. The droop characteristics of their governors are 4% and 5% respectively from no load to full load. Assuming that the generators are operating at 50 Hz at no load, how would a load of 600 MW be shared between them? What will be the system frequency at this load? Assume free governor operation. **(05 Marks)**

Module-4

7 a. What is voltage collapse? Explain the phenomenon of voltage collapse using PV and QV diagrams. **(10 Marks)**

b. Three supply points A, B and C are connected to a common bus bar M. Supply point A is maintained at a nominal 275 KV and is connected to M through 275/132 KV transformer (0.1 pu reactance) and a 132 KV line of reactance 50 Ω. Supply point C is nominally at 275 KV and is connected to M by a 275/132 KV transformer (0.1 pu reactance) and a 132 KV line of 50 Ω reactance. Point 'B' is at 132 KV and is connected to M via 132 KV line of 50 Ω reactance. If at particular system load, the line voltage of M falls below its nominal value by 5 KV, calculate the magnitude of the reactive volt-ampere injection required at M to re-establish the original voltage.
Note: Take base $(KV)_B$ as 275 KV and PU values are expressed on a 500 MVA base. Ignore resistance throughout. **(10 Marks)**

OR

8 a. Discuss the following methods of injection of reactive power with necessary figures.
(i) Shunt capacitors and reactors (ii) Series capacitors
(iii) Synchronous compensators **(10 Marks)**

b. In the radial transmission system shown in Fig.Q8(b) all pu values are referred to the voltage bases shown and 100 MVA. Determine the power factor at which the generator must operate.

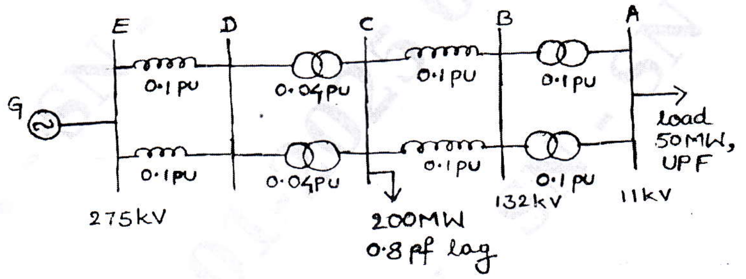

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. List out the factors affecting power system security. Explain Security Constrained Optimal Power Flow (SCOPF) with the help of an example. **(10 Marks)**

b. With a neat flow chart of contingency analysis using sensitivity factors, explain:
(i) Generation shift factors
(ii) Line outage distribution factors **(10 Marks)**

OR

10 a. With a neat flow chart, discuss the process involved in AC power flow security analysis with contingency case selection. **(10 Marks)**

b. Explain linear least square estimation with suitable equations. **(10 Marks)**

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