Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: B.Tech/IDD**
Sub_Code: REL6C001

6th Semester Regular/Back Examination: 2024-25
SUBJECT: Power System Operation and Control
BRANCH(S): EEE, ELECTRICAL, EE
Time: 3 Hours
Max Marks: 100
Q.Code: S130

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) Define the per-unit inertia constant of an alternator.
b) Define "load factor"?
c) Write the equality and inequality constraints for solving the economic load dispatch problem.
d) What are the different types of buses used for the load flow studies?
e) A power system network consists of 3 elements 0-1, 1-2, and 2-0 of impedances 0.2, 0.4 & 0.5, respectively. What is its bus impedance matrix?
f) Obtain the expression of the governor model in a single area control, showing the input-output relation.
g) What are Synchronizing Power Coefficients?
h) What is the significance of the Jacobian matrix in load-flow analysis?
i) What are the methods used for Power factor correction?
j) The PU value of impedance is 0.8 at base values of 400 MVA and 11 kv. Find the new PU values if the base values changed to 4400MVA and 33 kv.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) A power system has impedances between various buses
Bus 1 - reference j2Ω, bus 2 - reference j2Ω, bus 3 - reference j2Ω
Bus 1 to bus 3 j0.2Ω , 2 - 3 j0.4Ω ,1 - 4 j0.4Ω , 2 - 4 j0.4Ω , 3 - 4 j0.4Ω
Draw the configuration of the system and find the bus admittance matrix.
b) Explain unit commitment.
c) Compare the Gauss-Seidel load flow method with the Newton-Raphson method.
d) Derive the power angle equation for a synchronous generator and an infinite bus connected through a transmission line.
e) An incomplete nodal admittance matrix for a 4-bus system with negligible charging admittance is given below. Find the missing terms.

$$\begin{pmatrix} 0.7-j3 & -0.2+j1 & -0.5+j2 & Y_{14} \\ Y_{21} & Y_{22} & -0.3+j2 & -0.5+j3 \\ Y_{31} & Y_{32} & Y_{33} & -1+j4 \\ Y_{41} & Y_{42} & Y_{43} & Y_{44} \end{pmatrix}$$

f) The fuel inputs per hour of plants 1 and 2 are given as

$F_1 = 0.2P_1^2 + 40P_1 + 120$ Rs/hr

$F_2 = 0.25P_2^2 + 30P_2 + 150$ Rs/hr

Determine the economic operating schedule and the corresponding cost of generation. If the maximum and minimum loading on each unit is 25 MW and the demand is 180 MW and transmission losses are neglected. If the load is equally shared by both the unity. Determine the saving obtained by loading the units as per equal IPC?

g) Derive the expressions of critical clearing angle and critical clearing time.

h) What is a regulating transformer? What will be the change in the Ybus when a regulating transformer is present?

i) Derive the penalty factor in economic load dispatch problem?

j) A power system has a total load of 1260 MW at 60 Hz. The load varies by 1.5% for every 1% change in freq (D = 1.5). Find the steady-state frequency deviation when a 60 MW load is suddenly tripped, if I) There is no speed control.

II) The system has 240MW of spinning reserve evenly spread among 500 MW of generation capacity with 5% regulation based on this capacity. All other generations are operating with values wide open. Assume that the effect of governing dead bands is such that only 80% of the governor responds to the reduction in system load.

k) What is transient stability? How to improve transient stability of a power system?

l) 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 drop characteristics, supplies 400 MW, and Unit 2, which has a rated output of 500 MW and 5% speed drop, 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. Neglect losses

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four) **(16 x 2)**

Q3 A two bus system is shown in following figure. If 100 MW is transmitted from plant 1 to the load; a transmission loss of 10 MW is incurred. Find the required generation for each plant and the power received by the load when the system λ is Rs. 25 /MWh. The incremental fuel costs of the two plants are : **(16)**

$\frac{dF_1}{dP_1} = 0.02P_1 + 16$

$\frac{dF_2}{dP_2} = 0.04P_2 + 20$

Q4 What do you mean by load frequency control? Describe ALFC with block diagram. **(16)**

Q5 Derive the critical clearing angle for the fault that occurs at the busbar of the generator in a parallel transmission Line. **(16)**

Q6 Derive the swing equation of the rotor. Derive the condition of stability after following a disturbance. **(16)**