K. K. Wagh Institute of Engineering Education & Research, Nashik
(An Autonomous Institute From A.Y. 2022-23)

WINTER-2025	
Exam Seat No.:	
Academic Year: 2025-2026	Semester: VII
Class: FINAL	Program: B.Tech
Branch Code: ELE	Pattern: 2022
Name of Course: Power System Operation and Control	Course Code: ELE224001
Max. Marks: 60	Duration: 2.30 Hrs.

Instructions: Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains 2 page(s).
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.
5. The last columns indicates the Course Outcome and level of Blooms Taxonomy of the Question/sub-question.

Marks CO

Question No. 1

1a) The fuel costs of two units are given by (P_G1, P_G2 in MW): (6) CO1

$F1 = 1.5 + 25 \cdot PG1 + 0.15 \cdot PG1^2$ Rs/h

$F2 = 1.7 + 35 \cdot PG2 + 0.16 \cdot PG2^2$ Rs/h

Find the optimum scheduling neglecting transmission losses for a demand of 180 MW.

Question No. 2

2a) A two-pole, 50 Hz, 80 MVA turbogenerator has a moment of inertia $J = 8 \times 10^3$ kg·m². Calculate: (6) CO2
(a) the kinetic energy in MJ at rated speed,
(b) the inertia constants M and H,
(c) the inertia constant on an 80 MVA base.

Question No. 3

3a) What is meant by power system interconnection? Explain its advantages. (8) CO2

OR

3b) Discuss the following: (8) CO2

1. Capacity and diversity interchange
2. Inadvertent power exchange
3. Power pools

3c) Consider an interconnected power system consisting of two areas (Area 1 (A1) and Area 2 (A2)) connected by a tie-line. Each area has two generating units with the following cost functions (in $/h): (8) CO2

$$C = a_i P_i^2 + b_i P_i + C_i$$

The incremental cost characteristics of the units (in $/MWh) are:

Units	a_i ($/MW^2h$)	b_i ($/MWh)	c_i($/h)	P_{min} (MW)	P_{max} (MW)
A1. 1	0.002	2.4	100	0	500
A1. 2	0.005	1.6	120	0	500
A2. 1	0.004	3.2	400	0	500
A2. 2	0.006	1.8	250	0	500

The total system load demand is 700 MW, distributed as 350 MW in Area 1 and 350 MW in Area 2. Determine

- The optimal dispatch of the generating units of Area 1 and Area 2
- The optimal dispatch of the generating units when operated in an interconnected operation.

OR

3d) Consider an interconnected power system consisting of two areas (Area 1 (A1) and Area 2 (A2)) connected by a tie-line. Each area has two generating units with the following cost functions (in $/h): (8) CO2

$$C = a_i P_i^2+b_i P_i+C_i$$

The incremental cost characteristics of the units (in $/MWh) are:

Units	a_i ($/MW^2h$)	b_i ($/MWh)	c_i($/h)	P_{min} (MW)	P_{max} (MW)
A1. 1	0.002	2.4	100	0	500
A1. 2	0.005	1.6	120	0	500
A1. 3	0.001	1.2	150	0	500
A2. 1	0.004	3.2	400	0	500
A2. 2	0.006	1.8	250	0	500

The total system load demand is 550 MW, distributed as 250 MW in Area 1 and 300 MW in Area 2. Determine the saving in dollars ($) of the utilities when operated in interconnected operation and when operated isolated.

Question No. 4

4a) Compare the Gauss-Seidel, Newton-Raphson, and Fast Decoupled methods for solving load flow problems. (8) CO3

OR

4b) Illustrate and explain the objective of the Economic Load Dispatch (ELD) problem. Derive the general cost function of a thermal generating unit considering the valve-point effect. (8) CO3

4c) Explain how inequality constraints on control and dependent variables are handled in OPF problems. (8) CO3

OR

4d) Explain the steps to solve the optimal power flow problem considering equality constraints. (8) CO3

Question No. 5

5a) What is a vertically integrated utility? Discuss how such a structure enabled the existence of monopoly utilities in the early electricity industry. (8) CO3

OR

5b) Analyze the impact of power sector deregulation on consumers and private entities using a suitable example. (8) CO3

5c) Discuss the key reasons that led to the deregulation or restructuring of the power industry. (8) CO3

OR

5d) Explain the following terms (8) CO3

1. TRANSCO
2. DISCO
3. Market Operator

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