



**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:V
Class:TY	Program:B.Tech
Branch Code:ELE	Pattern:2023
Name of Course:Power System Analysis	Course Code:2306303
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) A portion of a power system consists of two generators in parallel, connected to a step-up transformer that links them with a 230 kV transmission line. The ratings of the components are: (6) CO1, CO2  
Generator G<sub>1</sub>: 8 MVA, 12% reactance  
Generator G<sub>2</sub>: 10 MVA, 6% reactance  
Transformer: 15 MVA, 10% reactance  
Transmission Line:  $Z = 5 + j70 \Omega$ , voltage base = 230 kV  
Convert all reactances and impedances to a 15 MVA base using the per-unit system.

**Question No. 2**

- 2a) Explain the concept of bus incidence matrix and Formation of YBUS. (6) CO1, CO4

**Question No. 3**

- 3a) What are current limiting reactors? Classify them. (8) CO1, CO2, CO3

**OR**

- 3b) With the help of a well-labelled diagram, explain the working of a generator reactor. Also, discuss the main advantages and disadvantages of using generator reactors. (8) CO1, CO2, CO3
- 3c) A 3-phase alternator is rated at 10 MVA, 12 kV and has an internal reactance of 6%. It is required to limit the steady-state short-circuit apparent power to no more than five times the full-load value. Determine: (i) The reactance of the limiting reactor in per unit (p.u.), and (ii) The corresponding reactance per phase in ohms. (8) CO1, CO2, CO3

**OR**

- 3d) A 10 MVA, 6.6 kV, 3-phase, star-connected alternator having a reactance of 20% is connected through a 5 MVA, 6.6/33 kV transformer with a reactance of 10% to a transmission line. The transmission line has a resistance of 0.2  $\Omega$ /km and a reactance of 1.0  $\Omega$ /km per conductor. A three-phase short-circuit fault occurs 50 km away from the transformer terminals (i.e., between the three (8) CO1, CO2, CO3

conductors). Draw the single-line diagram of the system. Also, calculate the fault current fed by the alternator. Assume the base MVA as 5.

**Question No. 4**

- 4a) Draw the zero-sequence network for the following transformer connections (8) CO1, CO2, CO3
- (i) Delta – Star
  - (ii) Star – star ground
  - (iii) Star grounded with impedance – Star grounded with impedance.
  - (iv) Star - Star

**OR**

- 4b) Derive the expression for fault current for a Line to Line to ground fault on an unloaded generator. Use a well-labeled diagram to show the fault current. (8) CO1, CO2, CO3
- 4c) A 3-phase, 3-wire system operates at a line-to-line voltage of 10.4 kV. It is supplied by a 15 MVA generator whose positive-, negative-, and zero-sequence reactances are  $0.6 \Omega$ ,  $0.5 \Omega$ , and  $0.2 \Omega$  per phase, respectively. Determine the per-unit sequence impedances of the generator, taking a base of 15 MVA and 10.4 kV. Also, calculate the fault current that flows when a line-to-line fault occurs directly at the generator terminals, expressing your answer in both per-unit and amperes. (8) CO1, CO2, CO3

**OR**

- 4d) In a 3-phase, 4-wire system, the line currents under abnormal loading conditions are given as  $I_R=100 \text{ A}$ ,  $I_Y=200-j100 \text{ A}$ ,  $I_B=50+j50 \text{ A}$ . Determine the positive-, negative-, and zero-sequence components of the R-phase current. Also, calculate the neutral current flowing in the system. (8) CO1, CO2, CO3

**Question No. 5**

- 5a) Derive the equal area criterion using the swing equation and power-angle diagram. (8) CO1, CO3, CO4

**OR**

- 5b) Differentiate between steady state, transient, and dynamic stability with appropriate examples. (8) CO1, CO3, CO4
- 5c) A double-circuit three-phase feeder connects a single generator to a large network. The steady-state stability limit for each circuit is 120 MW. The line is transmitting 100 MW when one of the circuits is suddenly switched out. Determine, with reference to the power-angle diagram, whether the generator is likely to remain in synchronism. (8) CO1, CO3, CO4

**OR**

- 5d) A two-pole, 50 Hz, 80 MVA turbogenerator with a moment of inertia of  $8 \times 10^3 \text{ kg-m}^2$  Tasks: Calculate kinetic energy in MJ at rated speed Find inertia constants  $H$  and  $M$  Convert  $M$  to per-unit on a 70 MVA base. (8) CO1, CO3, CO4

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