

KATHMANDU UNIVERSITY
End Semester Examination
December, 2024

Marks Scored:

Level : B.E.

Year : IV

Exam Roll No. :

Time: 30 mins.

Course : EPEG 413

Semester : I

F. M. : 10

Registration No.:

Date :

26 DEC 2024

SECTION "A"

[20Q. \times 0.5 = 10 marks]

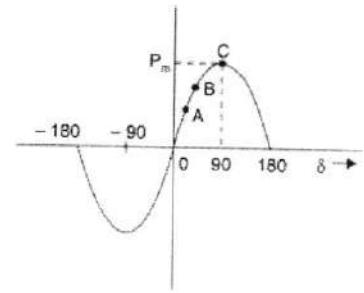
Choose the most appropriate answer and **encircle**.

- In a single phase supply, if the instantaneous voltage is $V_m \cos(\omega t + \theta_1)$ and the instantaneous current is $I_m \cos(\omega t + \theta_2)$, the instantaneous power is given by
 - $V_m I_m \cos(\omega t + \theta_1) \cos(\omega t - \theta_2)$
 - $V_m I_m \cos(\omega t + \theta_1) \cos(\omega t + \theta_2)$
 - $V_m I_m \cos(\omega t - \theta_1) \cos(\omega t + \theta_2)$
 - $V_m I_m \cos(\omega t - \theta_1) \cos(\omega t - \theta_2)$
- If the load is purely capacitive,
 - The current leads the voltage by 90°
 - The current lags the voltage by 90°
 - The current leads the voltage by 45°
 - The current lags the voltage by 45°
- In case of Y connected loads,
 - The line voltage is 3 times the magnitude of the phase voltage
 - The line voltage is $\sqrt{3}$ times the magnitude of the phase voltage
 - The phase voltage is 3 times the magnitude of the line voltage
 - The phase voltage is $\sqrt{3}$ times the magnitude of the line voltage
- For a short-circuit analysis of a salient pole synchronous generator, assuming a high X/R ratio, which one of the below is TRUE
 - d -axis reactance = q -axis reactance
 - d -axis reactance $\cong X_s$ (synchronous reactance used for the cylindrical rotor generator)
 - d -axis reactance = 0
 - $X_s = 0$
- Which one of this is true for the excitation current of the transformer?
 - Excitation current is usually about 50% of the rated current.
 - Rated current is usually about 50% of the excitation current.
 - Excitation current is usually less than 5% of the rated current.
 - Rated current is the usually less than 5% of the rated current.
- For the no-load test of the transformer
 - The primary current is the rated current and the losses measured by the wattmeter are basically the copper losses.
 - The primary current is the rated current and the losses measured by the wattmeter are basically the core losses.
 - The primary current is the excitation current and the losses measured by the wattmeter are basically the copper losses.
 - The primary current is the excitation current and the losses measured by the wattmeter are basically the core losses.

7. Swing bus is also known as
 a. Generation Bus b. Load Bus c. Slack Bus d. None of the above
8. If both a generator and a load are connected at a particular bus as shown in the figure, the net injected real and reactive power in the bus is given by:
 a. $P_G - P_L, Q_G - Q_L$
 b. $P_G - P_L, Q_L - Q_G$
 c. $-(P_G - P_L), -(Q_G - Q_L)$
 d. $-(P_G - P_L), Q_G - Q_L$
-
9. Load flow is generally carried out for
 a. Fault calculation b. Stability studies
 c. System planning d. Load frequency control
10. In a Bus admittance matrix
 a. Self-admittance is equal to the sum of admittances connected to it
 b. Self-admittance is equal to the negative of the admittance between the nodes
 c. Self-admittance is equal to the transfer admittance
 d. Self-admittance is equal to the transfer impedance
11. When a balanced three phase short-circuit fault occurs on the terminal of a synchronous machines, the fault current consists of
 a. Only the fundamental frequency component
 b. A fundamental component and a dc component
 c. A fundamental component and a double-frequency component
 d. A fundamental frequency component, a dc component and a double-frequency component.
12. Which one of this is true for salient pole synchronous generator reactance?
 a. $X_q' < X_d' < X_q'' < X_d''$ b. $X_q' > X_q'' > X_d' > X_d''$
 c. $X_q' > X_d' > X_q'' > X_d''$ d. $X_q' < X_q'' < X_d'' < X_d'$
13. The symmetrical components for the three phase unbalanced currents $I_a = 10 \angle 0^\circ$, $I_b = 10 \angle 230^\circ$, and $I_c = 10 \angle 130^\circ$ are given by
 a. $I_{a1} = 9.899 \angle 0^\circ, I_{a2} = 1.053 \angle 0^\circ, I_{a0} = 0.952 \angle 180^\circ$
 b. $I_{a1} = 1.053 \angle 0^\circ, I_{a2} = 9.899 \angle 0^\circ, I_{a0} = 0.952 \angle 180^\circ$
 c. $I_{a1} = 0.952 \angle 180^\circ, I_{a2} = 1.053 \angle 0^\circ, I_{a0} = 9.899 \angle 0^\circ$
 d. $I_{a1} = 0.952 \angle 180^\circ, I_{a2} = 9.899 \angle 0^\circ, I_{a0} = 1.053 \angle 0^\circ$
14. The zero-sequence impedance of a loaded synchronous machine is given by
 a. $Z_0 = 3Z_n$ b. $Z_0 = Z_1 + Z_2 - 3Z_n$ c. $Z_0 = Z_s + 3Z_n$ d. $Z_0 = Z_s$
15. In a three-phase system, the condition $I_a = 0, I_b + I_c = 0$ represents a
 a. Three phase short circuit fault b. Single line to ground fault
 c. Double line to ground fault d. Line to line fault

16. In the power angle curve shown, the system is stable between

- a. $-90^\circ - 90^\circ$
- b. $0 - 90^\circ$
- c. $0^\circ - 180^\circ$
- d. $-180^\circ - 180^\circ$



17. In the power angle curve shown above, P_m is called

- a. Transient stability limit
- b. Dynamic stability limit
- c. Steady state stability limit
- d. Small signal stability limit

18. Equal area criteria give the information about

- a. Stability region
- b. Swing curves
- c. Symmetrical faults
- d. Unsymmetrical faults

19. A 20 MVA, 13.2 kV generator has an inertia constant of 9.0 kW-sec/kVA, the kinetic energy store at the synchronous speed is given by

- a. 118.8 MJ
- b. 180 MJ
- c. 164 MJ
- d. 2376 MJ

20. Which one of the following is true for the equivalent inertia of two machines that swing together?

- a. $M_{eq} = M_1 + M_2$
- b. $M_{eq} = M_1 - M_2$
- c. $M_{eq} = M_1 M_2 / (M_1 + M_2)$
- d. $M_{eq} = (M_1 + M_2) / M_1 M_2$

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F. M. : 40

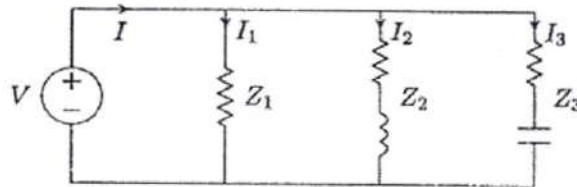
SECTION "B"

[4 Q. × 10 = 40 marks]

Attempt **ANY FOUR** questions.

1.

- a. Draw and label the parameters of the approximate equivalent circuit of a transformer. [3]
- b. What is Park Transformation? Briefly explain why is it used in the analysis of synchronous machines? [3]
- c. In the given circuit $V = 1200 \angle 0^\circ$ V, $Z_1 = 60 + j0$ ohm, $Z_2 = 6 + j12$ ohm, and $Z_3 = 30 - j30$ ohm. Find the power absorbed by each load and the total complex power. [4]

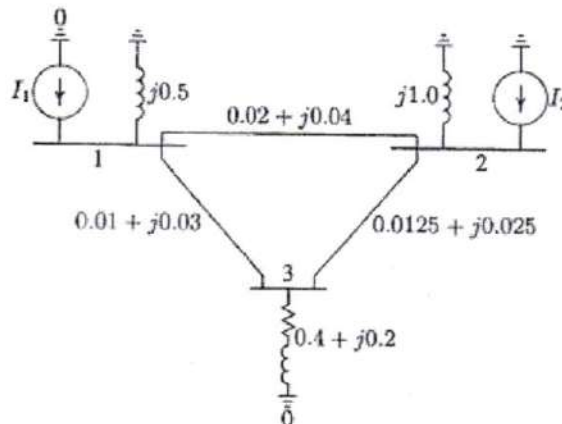


2.

- a. Discuss different types of stability problems in power system. What are the factors used for transient stability enhancement. [5]
- b. How is the Equal Area Criterion applied to analyze the stability of the system during faults in power system? Explain with a suitable figure. [5]

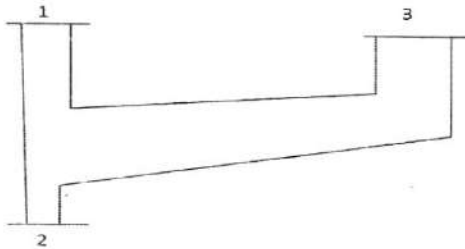
3.

- a. A power system network is shown in the figure. The values marked are impedances in per unit on a base of 100 MVA. Convert network impedances to admittances and determine the bus admittance matrix. [4]



P.T.O.

- b. Figure shows single line diagram of three bus power system with information given on the Tables.



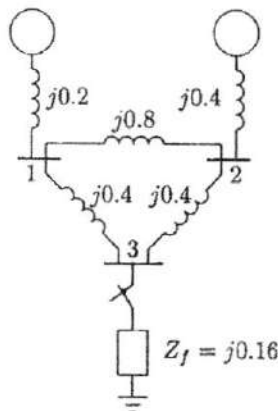
| Bus Code (i-k) | Impedance (Z_{ik}) |
|----------------|------------------------|
| 1-2 | $0.02+j0.04$ |
| 1-3 | $0.01+j0.03$ |
| 2-3 | $0.0125+j0.025$ |

| Bus Code (i) | Assumed bus voltage | Generation | | Load | |
|--------------|---------------------|------------|------|-------|-------|
| | | MW | MVAR | MW | MVAR |
| 1(slack bus) | $1.05+j0$ | - | - | 0 | 0 |
| 2(PV bus) | $1+j0$ | 50 | 30 | 305.6 | 140.2 |
| 3(PQ bus) | $1+j0$ | 0 | 0 | 138.6 | 45.2 |

Using Gauss-Seidel method, determine the voltages at bus 2 and 3 (Perform only two iterations) [6]

4.

- a. What is a Jacobian Matrix in the load flow analysis using Newton-Raphson Method? [2]
- b. Explain with the help of a figure what you understand by steady-state, transient and sub-transient state of a synchronous generator. [3]
- c. In the network shown in the figure below, all the impedances are expressed in pu on a common 100 MVA base. Determine the fault current when a balanced three-phase fault with a fault impedance $Z_f = 0.16$ pu occurs on Bus 3, as shown. [5]



5.

- a. What are symmetrical components? Discuss the occurrence of zero sequence current in power system. [4]
- b. Derive and draw sequence network diagram for a single line to ground fault. [6]