Machine Viva and Lab Questions with Answers

Answers

1. **Which condition cannot be checked using the 3-lamp method?**
   Answer: Exact phase angle difference. The method only shows approximate synchronization (all lamps dark = synchronized), but cannot quantify the exact phase difference.

2. **How can we know that the phase sequence is the same?**
   Answer: Lamps brighten sequentially in one direction. For ABC sequence, brightness rotates clockwise. If reversed, rotation is counterclockwise.

3. **Why is the OCC characteristic curved?**
   Answer: Magnetic saturation in iron core. Initially linear ($E \propto I_f$), then saturates:

$$E = \frac{kI_f}{1 + \alpha I_f} \quad (\alpha = \text{saturation factor})$$

4. **Why is rated voltage used in the locked rotor test?**
   Answer: To maintain normal flux density while limiting current. Voltage reduced to:

$$V_{LR} = V_{\text{rated}} \times \frac{I_{\text{rated}}}{I_{\text{sc}}}$$

5. **What are the shortcomings of the 3-lamp method?**
   Answer:

   - Cannot measure exact phase angle
   - No voltage magnitude check
   - Subjective brightness interpretation
   - Frequency differences not detected

6. **Why is the capacitor curve upward in synchronous generator load characteristics?**

Answer: Capacitors supply reactive power, increasing terminal voltage:

$$V_t = \sqrt{(E_a - I_a X_s \sin\theta)^2 + (I_a X_s \cos\theta)^2}$$

Leading power factor reduces voltage drop.

7. **What do Rc and Xm represent in equivalent circuit?**
   Answer:
   - R_c: Core loss resistance ($P_c = V^2/R_c$)
   - X_m: Magnetizing reactance (main flux path)

8. **Why does OCC saturate during Xs determination?**
   Answer: Iron core saturates at high field current:

$$X_s = \frac{V_{\text{OC}}}{I_{\text{SC}}} \quad \text{(unsaturated value from air-gap line)}$$

9. **What type of load does a synchronous motor take?**
   Answer: Can operate at any power factor: lagging (inductive), leading (capacitive), or unity.

10. **How to operate synchronous motor as capacitive load?**
    Answer: Over-excite field current ($I_f > I_{f,\text{rated}}$):

$$Q = \frac{3V_t E_f}{X_s}\cos\delta - \frac{3V_t^2}{X_s} > 0$$

11. **What is the significance of -Q in power systems?**
    Answer: $-Q$ denotes reactive power absorption (inductive loads). Essential for voltage control and stability.

12. **In no-load test, which value is rated and why?**
    Answer: Rated voltage. Core losses depend on voltage:

$$P_{\text{core}} \propto V^2$$

13. **In locked rotor test, which value is rated?**
    Answer: Rated current. Used to find copper losses at full load:

$$P_{\text{cu}} \propto I^2$$

14. **What does Rc represent?**
    Answer: Core loss resistance: $R_c = V^2/P_{\text{core}}$

15. **What does Xm represent?**
Answer: Magnetizing reactance: $X_m = V/I_m$

16. **Why does terminal voltage increase with capacitor load?**
Answer: Capacitors supply reactive power, reducing voltage drop:

$$\Delta V = I_q X_s \downarrow$$

17. **Which criteria cannot be fully fulfilled in 3-lamp method?**
Answer: Exact phase angle synchronization. Lamps darken over a range ($=\pm 10°$), not at exact zero.

18. **Which parameters cannot be detected?**
Answer: Voltage magnitude difference and exact frequency mismatch.

19. **How to increase active power?**
Answer: Increase mechanical input:

$$P = \frac{VE_f}{X_s} \sin\delta \quad \uparrow \text{ by } \uparrow \delta$$

20. **How to increase reactive power?**
Answer: Increase excitation:

$$Q = \frac{VE_f}{X_s} \cos\delta - \frac{V^2}{X_s} \quad \uparrow \text{ by } \uparrow E_f$$

21. **No-load current in induction motor?**
Answer: 30-60% of rated current. Primarily magnetizing current.

22. **Which torque-speed characteristics can be obtained?**
Answer: Linear region near synchronous speed (slip ¡ 5%) as full curve requires destructive testing.

23. **Why core saturates in OC but not SC test?**
Answer:

- OC: Full flux $\phi = kV$
- SC: $\phi_{\text{net}} \approx 0$ (armature reaction opposes field flux)

24. **Does reactance decrease with field current?**
Answer: No. Synchronous reactance (X_s) is constant, but *saturated reactance* decreases at high I_f.

25. **How to increase power sharing on infinite bus?**
Answer:
    - Active: ↑ mechanical input
    - Reactive: ↑ field excitation

26. **How to know phase angles equal in 3-lamp method?**
Answer: When all lamps are equally dark (minimum brightness).

27. **When synchronous machine at PF=1?**
Answer: When field current is adjusted for unity PF:

$$E_f \cos \delta = V$$

28. **What cannot be measured?**
Answer: Voltage magnitude difference and frequency difference.

29. **How to change power sharing?**
Answer: Adjust governor (active power) or exciter (reactive power).

30. **In DC test, which value rated?**
Answer: Rated current. Measures armature resistance at operating temperature.

31. **Core losses from which test?**
Answer: No-load test. Sums core losses + friction + windage.

32. **Why OC curve nonlinear but SC linear?**
Answer: OC saturates (iron core), SC remains linear (air-core equivalent).

33. **Torque vs load in induction motor?**
Answer: Torque proportional to slip near sync speed:

$$T \propto s \quad (s < s_{\max})$$

34. **Reactive power when active increases?**
Answer: For induction motors, Q increases with load due to leakage reactance:

$$Q \approx I^2 X_{\text{leak}}$$

35. **Speed when load changes?**
Answer: Induction motor: speed decreases (↑ slip). Synchronous motor: constant speed.

36. **Why current increases with load?**
Answer: To deliver more power:

$$P = VI\cos\phi \quad \Rightarrow \quad I \uparrow \text{ as } P \uparrow$$

37. **Why use linear part of torque-speed curve?**
Answer: Stable operation region where $T \propto s$ (predictable control).

38. **Active/reactive power vs load?**
Answer:

- Active power ↑ with load
- Reactive power ↑ (induction) or adjustable (synchronous)

39. **Why no core loss in induction motor equivalent circuit?**
Answer: Core loss is included in shunt branch (R_c). Common misconception - it *is* present.

40. **Active/reactive power when load increases?**
Answer: Both increase:

$$P = 3VI\cos\phi, \quad Q = 3VI\sin\phi$$

ϕ constant in syn motor, increases in ind motor.

41. **Meaning of -Q and +Q?**
Answer:

$$+Q : \text{Capacitive (supplied)}$$
$$-Q : \text{Inductive (absorbed)}$$

42. **How to apply load to synchronous motor?**
Answer: Mechanically: Increase shaft torque. Electrically: Increase field current for reactive load.

43. **Which parameter not perfectly achieved in paralleling?**
Answer: Exact phase angle synchronization (practical tolerance = $\pm 5°$).

44. **Ensure phase sequences aligned?**
Answer: Use phase sequence indicator or check lamp rotation direction.

45. **Why load current increases?**
Answer: To supply increased power demand:

$$I = \frac{P}{\sqrt{3}V \cos\phi}$$

46. **Reactive power sign change in induction motor?**
Answer:

- Light load: Large $-Q$ (magnetizing)
- Full load: Smaller $-Q$ (better PF)
- Never positive (always inductive)

Implies poor light-load power factor.