# DEPARTMENT OF ELECTRICAL ENGINEERING

# QUESTION BANK ON

# ENERGY CONVERSION-II

*MR. BIJAYA KUMAR BEHERA(LECTURER)*

*(5th Semester)*

## Department of Electrical Engineering

**NILASAILA INSTITUTE OF SCIENCE AND TECHNOLOGY**

(NIST POLYTECHNIC)

**(Approved By AICTE and Affiliated To SCTE&VT, Odisha)**

**SERGARH, BALASORE-756060, ODISHA**

**Email: nist.bls@gmail.com / Visit us: www.nist.org.in**

SINGLE PHASE INDUCTION MOTOR MCQS

1. In a split phase motor, the running winding should have
(a) high resistance and low inductance
(b) low resistance and high inductance
(c) high resistance as well as high inductance
(d) low resistance as well as low inductiance
Ans: b

2. If the capacitor of a single-phase motor is short-circuited
(a) the motor will not start
(b) the motor will run
(c) the motor will run in reverse direction
(d) the motor will run in the same direction at reduced r.p.m.
Ans: a

3. In capacitor start single-phase motors
(a) current in the starting winding leads the voltage
(b) current in the starting winding lags the voltage
(c) current in the starting winding is in phase with voltage in running winding
(d) none of the above
Ans: a

4. In a capacitor start and run motors the function of the running capacitor in series with the auxiliary winding is to
(a) improve power factor
(b) increase overload capacity
(c) reduce fluctuations in torque
(d) to improve torque
Ans: a

5. In a capacitor start motor, the phase displacement between starting and running winding can be nearly
(a) 10°
(b) 30°
(c) 60°
(d) 90°
Ans: d

6. In a split phase motor
(a) the starting winding is connected through a centrifugal switch
(b) the running winding is connected through a centrifugal switch
(c) both starting and running windings are connected through a centrifugal switch
(d) centrifugal switch is used to control supply voltage
Ans: a

7. The rotor developed by a single-phase motor at starting is
(a) more than i.he rated torque

(b) rated torque
(c) less than the rated torque
(d) zero
Ans: d

8. Which of the following motor will give relatively high starting torque ?
(a) Capacitor start motor
(b) Capacitor run motor
(c) Split phase motor
(d) Shaded pole motor
Ans: a

9. Which of the following motor will have relatively higher power factor ?
(a) Capacitor run motor
(b) Shaded pole motor
(c) Capacitor start motor
(d) Split phase motor
Ans: a

10. In a shaded pole motor, the shading coil usually consist of
(a) a single turn of heavy wire which is in parallel with running winding
(b) a single turn of heavy copper wire which is short-circuited and carries only induced current
(c) a multilayer fine gauge copper wire in parallel with running winding
(d) none of the above
Ans: b

11. In a shaded pole single-phase motor, the revolving field is produced by the use of
(a) inductor
(b) capacitor
(c) resistor
(d) shading coils
Ans: d

12. A centrifugal switch is used to dis- connect ‘starting winding when motor has
(a) run for about 1 minute
(b) run for about 5 minutes
(c) picked up about 50 to 70 per cent of rated speed
(d) picked up about 10 to 25 per cent of rated speed
Ans: c

13. If a particular application needs high speed and high starting torque, then which of the following motor will be
preferred ?
(a) Universal motor
(b) Shaded pole type motor

(c) Capacitor start motor
(d) Capacitor start and run motor
Ans: a

14. The value of starting capacitor of a fractional horse power motor will be
(a) 100 uF
(6) 200 uF
(c) 300 uF
(d) 400 uF
Ans: c

15. In repulsion motor direction of rotation of motor
(a) is opposite to that of brush shift
(b) is the same as that of brush shift
(c) is independent of brush shift
Ans: b

16. In a single phase motor the centrifugal switch
(a) disconnects auxiliary winding of the motor
(b) disconnects main winding of the motor
(c) reconnects the main winding the motor
(d) reconnects the auxiliary winding of the motor
Ans: a

17. The running winding of a single phase motor on testing with meggar is found to be ground. Most probable location of the ground will be
(a) at the end connections
(b) at the end terminals
(c) anywhere on the winding inside a slot
(d) at the slot edge where coil enters or comes out of the slot
Ans: d

18. A capacitor-start single phase induction motor is switched on to supply with its capacitor replaced by an inductor of equivalent reactance value. It will
(a) start and then stop
(b) start and run slowly
(c) start and run at rated speed
(d) not start at all
Ans: d

19. Which of the following motors is used in mixies ?
(a) Repulsion motor
(b) Reluctance motor
(c) Hysteresis motor
(d) Universal motor
Ans: d

20. Which of the following motors is inherently self starting ?
(a) Split motor
(b) Shaded-pole motor
(c) Reluctance motor
(d) None of these
Ans: b

21. The direction of rotation of an hysteresis motor is determined by
(a) interchanging the supply leads
(b) position of shaded pole with respect to main pole
(c) retentivity of the rotor material
(d) none of these
Ans: b

22. Burning out of windings is due to
(a) short circuited capacitor
(b) capacitor value hiving changed
(c) open circuiting of capacitor
(d) none of the above
Ans: a

23. Direction of rotation of a split phase motor can be reversed by reversing the connection of
(a) running winding only
(b) starting winding only
(c) either (a) or (b)
(d) both (a) and (b)
Ans: c

24. Short-circuiter is used in
(a) repulsion induction motor
(b) repulsion motor
(c) repulsion start induction run motor
(d) none of the above
Ans: c

25. The range of efficiency for shaded pole motors is
(a) 95% to 99%
(b) 80% to 90%
(c) 50% to 75%
(d) 5% to 35%
Ans: d

26. In a capacitor start single-phase motor, when capacitor is replaced by a resistance
(a) torque will increase
(b) the motor will consume less power

(c) motor will run in reverse direction
(d) motor will continue to run in same direction
Ans: d

27. The power factor of a single-phase induction motor is usually
(a) lagging
(b) always leading
(c) unity
(d) unity to 0.8 leading
Ans: a

28. A shaded pole motor can be used for
(a) toys
(b) hair dryers
(c) circulators
(d) any of the above
Ans: d

29. A hysteresis motor works on the principle of
(a) hysteresis loss
(b) magnetisation of rotor
(c) eddy current loss
(d) electromagnetic induction
Ans: a

30. Which of the following motor will give the highest starting torque ?
(a) D.C. shunt motor
(b) Schrage motor
(c) Repulsion start and induction run motor
(d) Universal motor
Ans: b

31. For which of the applications a reluctance motor is preferred ?
(a) Electric shavers
(b) Refrigerators
(c) Signalling and timing devices
(d) Lifts and hoists
Ans: c

32. The motor used on small lathes is usually
(a) universal motor
(b) D.C. shunt motor
(c) single-phase capacitor run motor
(d) 3-phase synchronous motor
Ans: c

33. Which of the following motors is preferred for tape-recorders ?
(a) Shaded pole motor
(b) Hysteresis motor
(c) Two value capacitor motor
(d) Universal motor
Ans: b

34. A single-phase induction motor is
(a) inherently self-starting with high torque
(b) inherently self-starting with low torque
(c) inherently non-self-starting with low torque
(d) inherently non-self-starting with high torque
Ans: c

35. A schrage motor can run on
(a) zero slip
(b) negative slip
(c) positive slip
(d) all of the above
Ans: d

36. A universal motor can run on
(a) A.C. only
(6) D.C. only
(c) either A.C. or D.C.
(d) none of the above
Ans: c

37. Which of the following single-phase motors is suitable for timing and control purposes ?
(a) Reluctance motor
(b) Series motor
(c) Repulsion motor
(d) Universal motor
Ans: a

38. Single phase induction motor usually operates on
(a) 0.6 power factor lagging
(b) 0.8 power factor lagging
(c) 0.8 power factor leading
(d) unity power factor
Ans: a

39. In split-phase motor auxiliary winding is of
(a) thick wire placed at the bottom of the slots
(b) thick wire placed at the top of the slots
(c) thin wire placed at the top of the slots

(d) thin wire placed at the bottom of the slots
Ans: c

40. Which of the following motors will operate at high power factor ?
(a) Shaped pole motor
(b) Split phase motor
(c) Capacitor start motor
(d) Capacitor run motor
Ans: d

41. In a two value capacitor motor, the capacitor used for running purposes is
(a) air capacitor
(b) paper spaced oil filled type
(c) ceramic type
(d) a.c. electrolytic type
Ans: b

42. Which of the following motors can be run on AC. as well as D.C. supply ?
(a) Universal motor
(b) Repulsion motor
(c) Synchronous motor
(d) Reluctance motor
Ans: a

43. In A.C. series motor compensating winding is employed to
(a) reduce the effects of armature reaction
(b) increase the torque
(c) reduce sparking at the brushes
(d) none of the above
Ans: c

44. Which of the following single-phase induction motors is generally used in time phonographs ?
(a) Resistance start
(b) Capacitor start capacitor run
(c) Shaded pole
(d) Universal
Ans: c

45. Which of the following motors has highest starting torque ?
(a) Repulsion motor
(b) Shaped pole motor
(c) Capacitor-start motor
(d) Split-phase motor
Ans: c

46. The repulsion-start induction-run motor is used because of
(a) good power factor
(b) high efficiency
(c) minimum cost
(d) high starting torque
Ans: d

47. In case of a shaded pole motor the direction of rotation of the motor is
(a) from main pole to shaded pole
(b) from shaded pole to main pole
(c) either of the above depending on voltage
(d) either of the above depending on power factor
Ans: a

48. In case of high speed universal motor which of the following needs more attention ?
(a) End play
(b) Air gap
(c) Insulation in rotor
(d) Balancing of rotor
Ans: d

49. The wattage rating for a ceiling fan motor will be in the range
(a) 200 to 250 W
(b) 250 to 500 W
(c) 50 to 150 W
(d) 10 to 20 W
Ans: c

50. The wattage of motor for driving domestic sewing machine will be around
(a) 100 to 150 W
(b) 40 to 75 W
(c) 10 to 30 W
(d) 5 to 10 W
Ans: a

51. Which of the following single-phase motors has relatively poor starting torque ?
(a) Universal motor
(b) Repulsion motor
(c) Capacitor motor
(d) All single phase motors have zero starting torque
Ans: c

52. Which type of load is offered by cranes and hoists ?
(a) Gradually varying load
(b) Non-reversing, no-load start
(c) Reversing, light start

(d) Reversing, heavy start
Ans: d

53. The speed of a universal motor is generally reduced by using
(a) gear trains
(b) V-belts
(c) brakes
(d) chains
Ans: a

54. Which of the following motors can be used for unity power factor ?
(a) Capacitor run motor
(b) Shaded pole motor
(c) Hysteresis motor
(d) Schrage motor
Ans: d

55. When a D.C. series motor is connected to A.C. supply, the power factor will be low because of
(a) high inductance of field and armature circuits
(b) induced current in rotor due to variations of flux
(c) fine copper wire winding
(d) none of the above
Ans: a

56. The direction of rotation of universal motor can be reversed the by reversing the flow of current through
(a) armature winding
(b) field winding
(c) either armature winding or field winding
(d) none of the above
Ans: c

57. In which single-phase motor, the rotor has no teeth or winding ?
(a) Split phase motor
(b) Reluctance motor
(c) Hysteresis motor
(d) Universal motor
Ans: c

58. Which motor is normally free from mechanical and magnetic vibrations ?
(a) Split phase motor
(b) Universal motor
(c) Hysteresis motor
(d) Shaded pole motor
Ans: c

59. As hysteresis motors are free from mechanical and magnetic vibrations therefore these are considered as suitable for
(a) fans
(b) blowers
(c) sound equipment
(d) mixer grinders
Ans: c

60. A reluctance motor
(a) is self-starting
(b) is constant speed motor
(c) needs no D.C. excitation
(d) all of the above
Ans: d

61. In a hysteresis motor, the rotor must have
(a) retentivity
(b) resistivity
(c) susceptibility
(d) none of the above
Ans: a

62. The rotor of a hysteresis motor is made of
(a) aluminium
(b) cast iron
(c) chrome steel
(d) copper
Ans: c

63. The electric motor used in portable drills is
(a) capacitor run motor
(b) hysteresis motor
(c) universal motor
(d) repulsion motor
Ans: c

64. Which of the following applications always have some load whenever switched on ?
(a) Vacuum cleaners
(b) Fan motors
(c) Pistol drills
(d) All of the above
Ans: c

65. The speed control of universal motor used for sewing machines is by
(a) friction
(b) varying the resistance

(c) tapping the field
(d) centrifugal mechanism
Ans: b

66. Torque developed by a single phase induction motor at starting is
(a) pulsating
(b) uniform
(c) none of the above
(d) nil
Ans: d

67. In split phase motor main winding is of
(a) thin wire placed at the top of the slots
(b) thin wire placed at the bottom of the slots
(c) thick wire placed at the bottom of the slots
(d) thick wire placed at the top of the" slots
Ans: c

68. In repulsion motor, maximum torque is developed when
(a) brush axis is at 45° electrical to the field axis
(b) brush axis coincides with the field axis
(c) brush axis is at 90° electrical to the field axis
(d) none of the above
Ans: a

69. If the centrifugal switch does not open at 70 to 80 percent of synchronous speed of motor, it would result in
(a) damage to the starting winding
(b) damage to the centrifugal switch
(c) overloading of running winding
(d) none of the above
Ans: a

70. Speed torque characteristic of a repulsion induction motor is similar to that of a D.C.
(a) shunt motor
(b) series motor
(c) compound motor
(d) separately excited motor
Ans: c

71. In a ceilingfan employing capacitor run motor
(a) secondary winding surrounds the primary winding
(b) primary winding surrounds the secondary winding
(c) both are usual arrangements
(d) none of the above
Ans: a

72. The shaded pole motor is used for
(a) high starting torque
(b) low starting torque
(c) medium starting torque
(d) very high starting torque
Ans: b

73. The rotor slots, in an induction motor, are usually not quite parallel to the shaft because it
(a) improves the efficiency
(b) helps the rotor teeth to remain under the stator teeth
(c) helps in reducing the tendency of the rotor teeth to remain under the stator teeth
(d) improves the power factor
Ans: c

74. The speed/load characteristics of a universal motor is same as that of
(a) A.C. motor
(b) D.C. shunt motor
(c) D.C. series motor
(d) none of the above
Ans: c

75. The purpose of stator winding in the compensated repulsion motor is to
(a) provide mechanical balance
(b) improve power factor and provide better speed regulation
(c) prevent hunting in the motor
(d) eliminate armature reaction
Ans: b

76. Which of the following motors is used for unity power factor ?
(a) Hysteresis motor
(b) Schrage motor
(c) Universal motor
(d) Reluctance motor
Ans: b

77. The motor used for the compressors is
(a) d.c. series motor
(b) shaded pole motor
(c) capacitor-start capacitor-run motor
(d) reluctance motor
Ans: c

78. Which of the following motors is used in a situation where load increases with speed ?
(a) Induction motor

(b) Three-phase series motor
(c) Schrage motor
(d) Hysteresis motor
Ans: b

79. In repulsion motor, zero torque is developed when
(a) brush axis is 45° electrical to field axis
(b) brush axis coincides with the field axis
(c) brush axis is 90° electrical to field axis
(d) both (b) and (c)
Ans: d

80. Centrifugal switch disconnects the auxiliary winding of the motor at about _____percent of synchronous speed
(a) 30 to 40
(b) 70 to 80
(c) 80 to 90
(d) 100
Ans: b

81. Starting winding of a single phase motor of a refrigerator is disconnected from the circuit by means of a
(a) magnetic relay
(b) thermal relay
(c) centrifugal switch
(d) none of the above
Ans: a

82. If a single phase induction motor runs slower than normal, the most likely defect is
(a) worn bearings
(b) short-circuit in the winding
(c) open-circuit in the winding
(d) none of the above
Ans: a

83. Which of the following motors is used in tape-recorders ?
(a) Hysteresis motor
(b) Reluctance motor
(c) Capacitor-run motor
(d) Universal motor
Ans: a

84. Which of the following statements regarding two value capacitor motor is incorrect ?
(a) It is a reversing motor
(b) It is preferred to permanent-split single-value capacitor motor where frequent

reversals are required
(c) It has low starting as well as rushing currents
(d) It has high starting torque
Ans: b

85. Two-value capacitor motor finds increased application as compressor motor in small home air-conditioners
because
(a) it is comparatively cheaper
(b) it has almost non-destructible capacitor
(c) it has low starting as well as running currents at relatively high power factor
(d) it is quiet in operation
Ans: c

86. If the centrifugal switch of a two-value capacitor motor using two capacitors fails to open then
(a) motor will not come up to speed
(b) motor will not carry the load
(c) current drawn by the motor will be excessively high
(d) electrolytic capacitor will, in all probability, suffer break down
Ans: d

87. In a universal motor, the most common cause of brush sparking is
(a) open armature winding
(b) shorted armature winding
(c) shorted field winding"
(d) high commutator mica
(e) all of the above
Ans: e

88. If starting winding of a single-phase induction motor is left in the circuit, it will
(a) run faster
(b) spark at light loads
(c) draw excessive current and overheat
(d) run slower
Ans: c

89. Most of the fractional horsepower motors have either
(a) hard and annealed bearings
(b) ball or roller bearings
(c) soft and porous bearings
(d) plain or sleeve bearings
Ans: d

90. Which of the following statements regarding reluctance-start motor is incorrect ?

(a) It is similar to reluctance motor
(b) It is basically an induction motor and not a synchronous one
(c) So far as its basic working principle is concerned, it is similar to shaded pole motor
(d) the air-gap between rotor and salient poles is non- uniform
Ans: a

91. To reverse the direction of rotation of acapacitor start motor while it is running we should
(a) disconnect motor from the supply till it stops then reconnect it to supply with reversed connection of main or auxiliary winding
(b) disconnect motor from supply and immediately reconnect it to supply with reversed connections of the main winding
(c) reverse the direction of connection of the auxiliary winding and after motor comes to rest then connect auxiliary winding to the supply
(d) reverse the direction of connections of the auxiliary winding and immediately connect it to supply
Ans: a

92. In case of a reluctance motor, when the load is increased so that it cannot maintain synchronous speed the motor will
(a) become unstable
(b) draw excessive armature current and may burn out
(c) fall out of synchronism and come to stand still
(d) run as induction motor
Ans: d

93. Which of the following motors has two separate windings on the motor ?
(a) Repulsion motor
(b) Repulsion induction motor
(c) Repulsion start induction run motor
(d) None of the above
Ans: b

94. A shaded pole motor does not possess
(a) centrifugal switch
(b) capacitor
(c) commutator
(d) all of the above
Ans: d

95. In a A.C. series motor armature coils are usually connected to commutator
(a) through resistance
(b) through reactances
(c) through capacitors
(d) solidly
Ans: a

96. Which of the following statements regarding a reluctance motor is incorrect ?
(a) It cannot be reversed, ordinarily
(b) It requires no D.C. field excitation for its operation
(c) It is nothing else but a single-phase, salient pole synchronous-induction motor
(d) Its squirrel cage-rotor is of unsym-metrical magnetic construction in order to vary reluctance path between stator and rotor
Ans: a

97. A universal motor is one which
(a) can be operated either on D.C. or A.C. supply at approximately the same speed and output
(b) can be marketed internationally
(c) runs at dangerously high speed on no-load
Ans: a

98. A repulsion motor is equipped with
(a) slip rings
(b) commutator
(c) both (a) and (b)
(d) none of the above
Ans: b

99. The capacitors used in single-phase capacitor motors have no
(a) voltage rating
(b) dielectric medium
(c) polarity marking
(d) definite value
Ans: c

100. If a D.C. series motor is operated on A.C. supply, it will
(a) spark excessively
(b) have poor efficiency
(c) have poor power factor
(d) all of the above
Ans: d

101. After the starting winding of a single phase induction motor is disconnected from supply, it continues to run only on
(a) running winding
(b) rotor winding
(c) field winding
(d) compensating winding
Ans: a

102. Which of the following statements regarding repulsion-start induction motor is incorrect ?
(a) It requires more maintenance of commutator and other mechanical devices

(b) It makes quite a bit of noise on starting
(c) In fractional horse power motors, it has replaced the capacitor motors
(d) It is not easily reversed
Ans: c

103. A.C. series motor as compared to D.C. series motor has
(a) smaller brush width
(b) less number of field turns
(c) more number of armature turns
(d) less air gap
(e) all of the above
Ans: e

104. Locked rotor current of a shaded pole motor is
(a) equal to full load current
(b) less than full load current
(c) slightly more than full load current
(d) several times the full load current
Ans: c

105. Speed control of a universal motor is achieved by
(a) varying field flux with tapped field windings
(b) connecting rheostat in series
(c) applying variable voltage by means of silicon controlled rectifier
(d) applying variable voltage by means of variable auto-transformer
(e) all of the above methods
Ans: e

116. Hysteresis motor is particularly useful for high-quality record players and tape-recorders because
(a) it revolves synchronously
(b) it is not subject to any magnetic or mechanical vibrations
(c) it can be easily manufactured in extremely small sizes of up to 1 W output
(d) it develops hysteresis torque which is extremely steady both in amplitude and phase
Ans: d

117. Which of the following statements regarding hysteresis motor is in incorrect ?
(a) It is extremely sensitive to fluctuations in supply voltage
(b) Its high starting torque is due to its high rotor hysteresis loss
(c) It is extremely quiet in operation
(d) It accelerates from rest to full-speed almost instantaneously
Ans: a

118. Which of the following statements regarding single-phase induction motoris correct ?
(a) It requires only one winding

(b) It can rotate in one direction only
(c) It is self-starting
(d) It is not self-starting
Ans: d

119. The starting winding of a single-phase motor is placed in
(a) armature
(b) field
(c) rotor
(d) stator
Ans: d

120. The speed of a universal motor is usually reduced by using
(a) gearing
(b) belts
(c) brakes
(d) chains
Ans: a

# MCQS ON 3 PHASE INDUCTION MACHINE

1. Which of the following component is usually fabricated out of silicon steel ?
(a) Bearings
(b) Shaft
(c) Statorcore
(d) None of the above
Ans: c
2. The frame of an induction motor is usually made of
(a) silicon steel
(b) cast iron
(c) aluminium
(d) bronze
Ans: b
3. The shaft of an induction motor is made of
(a) stiff
(b) flexible
(c) hollow
(d) any of the above
Ans: a
4. The shaft of an induction motor is made of
(a) high speed steel
(b) stainless steel
(c) carbon steel
(d) cast iron
Ans: c
5. In an induction motor, no-load the slip is generally
(a) less than 1%
(b) 1.5%
(c) 2%
(d) 4%
Ans: a
6. In medium sized induction motors, the slip is generally around
(a) 0.04%
(b) 0.4%
(c) 4%

(d) 14%
Ans: c
7. In squirrel cage induction motors, the rotor slots are usually given slight skew in order to
(a) reduce windage losses
(b) reduce eddy currents
(c) reduce accumulation of dirt and dust
(d) reduce magnetic hum
Ans: d
8. In case the air gap in an induction motor is increased
(a) the magnetising current of the rotor will decrease
(b) the power factor will decrease
(c) speed of motor will increase
(d) the windage losses will increase
Ans: b
9. Slip rings are usually made of
(a) copper
(b) carbon
(c) phospor bronze
(d) aluminium
Ans: c
10. A 3-phase 440 V, 50 Hz induction motor has 4% slip. The frequency of rotor e.m.f. will be
(a) 200 Hz
(b) 50 Hz
(c) 2 Hz
(d) 0.2 Hz
Ans: c
11. In Ns is the synchronous speed and s the slip, then actual running speed of an induction motor will be
(a) Ns
(b) s.N,
(c) (l-s)Ns
(d) (Ns-l)s
Ans: c

The efficiency of an induction motor can be expected to be nearly
(a) 60 to 90%
(b) 80 to 90%
(c) 95 to 98%
(d) 99%
Ans: b
13. The number of slip rings on a squirrel cage induction motor is usually
(a) two
(b) three
(c) four
(d) none
Ans: d
14. The starting torque of a squirrel-cage induction motor is
(a) low
(b) negligible
(c) same as full-load torque
(d) slightly more than full-load torque
Ans: a
15. A double squirrel-cage induction motor has
(a) two rotors moving in oppsite direction
(b) two parallel windings in stator
(c) two parallel windings in rotor
(d) two series windings in stator
Ans: c
16. Star-delta starting of motors is not possible in case of
(a) single phase motors
(b) variable speed motors
(c) low horse power motors
(d) high speed motors
Ans: a
17. The term ‘cogging’ is associated with
(a) three phase transformers
(b) compound generators
(c) D.C. series motors

(d) induction motors

Ans: d

18. In case of the induction motors the torque is

(a) inversely proportional to (Vslip)

(b) directly proportional to (slip)2

(c) inversely proportional to slip

(d) directly proportional to slip

Ans: d

19. An induction motor with 1000 r.p.m. speed will have

(a) 8 poles

(b) 6 poles

(c) 4 poles

(d) 2 poles

Ans: b

20. The good power factor of an induction motor can be achieved if the average flux density in the air gap is

(a) absent

(b) small

(c) large

(d) infinity

Ans: b

21. An induction motor is identical to

(a) D.C. compound motor

(b) D.C. series motor

(c) synchronous motor

(d) asynchronous motor

Ans: d

22. The injected e.m.f. in the rotor of induction motor must have

(a) zero frequency

(b) the same frequency as the slip frequency

(c) the same phase as the rotor e.m.f.

(d) high value for the satisfactory speed control

Ans: b

23. Which of the following methods is easily applicable to control the speed of the squirrel-cage induction motor ?

(a) By changing the number of stator poles
(b) Rotor rheostat control
(c) By operating two motors in cascade
(d) By injecting e.m.f. in the rotor circuit
Ans: a
24. The crawling in the induction motor is caused by
(a) low voltage supply
(b) high loads
(c) harmonics develped in the motor
(d) improper design of the machine
(e) none of the above
Ans: c
25. The auto-starters (using three auto transformers) can be used to start cage induction motor of the following type
(a) star connected only
(b) delta connected only
(c) (a) and (b) both
(d) none of the above
Ans: c
26. The torque developed in the cage induction motor with autostarter is
(a) k/torque with direct switching
(6) K x torque with direct switching
(c) K2 x torque with direct switching
(d) k2/torque with direct switching
Ans: c
27. When the equivalent circuit diagram of doouble squirrel-cage induction motor is constructed the two cages can be
considered
(a) in series
(b) in parallel
(c) in series-parallel
(d) in parallel with stator
Ans: b
28. It is advisable to avoid line-starting of induction motor and use starter because
(a) motor takes five to seven times its full load current

(b) it will pick-up very high speed and may go out of step
(c) it will run in reverse direction
(d) starting torque is very high
Ans: a
29. Stepless speed control of induction motor is possible by which of the following methods ?
(a) e.m.f. injection in rotor eueuit
(b) Changing the number of poles
(c) Cascade operation
(d) None of the above
Ans: b
30. Rotor rheostat control method of speed control is used for
(a) squirrel-cage induction motors only
(b) slip ring induction motors only
(c) both (a) and (b)
(d) none of the above
Ans: b
31. In the circle diagram for induction motor, the diameter of the circle represents
(a) slip
(b) rotor current
(c) running torque
(d) line voltage
Ans: b
32. For which motor the speed can be controlled from rotor side ?
(a) Squirrel-cage induction motor
(b) Slip-ring induction motor
(c) Both (a) and (b)
(d) None of the above
Ans: b
33. If any two phases for an induction motor are interchanged
(a) the motor will run in reverse direction
(b) the motor will run at reduced speed
(c) the motor will not run
(d) the motor will burn
Ans: a

34. An induction motor is
(a) self-starting with zero torque
(b) self-starting with high torque
(c) self-starting with low torque
(d) non-self starting
Ans: c
35. The maximum torque in an induction motor depends on
(a) frequency
(b) rotor inductive reactance
(c) square of supply voltage
(d) all of the above
Ans: d
36. In three-phase squirrel-cage induction motors
(a) rotor conductor ends are short-circuited through slip rings
(b) rotor conductors are short-circuited through end rings
(c) rotor conductors are kept open
(d) rotor conductors are connected to insulation
Ans: b
37. In a three-phase induction motor, the number of poles in the rotor winding is always
(a) zero
(b) more than the number of poles in stator
(c) less than number of poles in stator
(d) equal to number of poles in stator
Ans: d
38. DOL starting of induction motors is usually restricted to
(a) low horsepower motors
(b) variable speed motors
(c) high horsepower motors
(d) high speed motors
Ans: a
39. The speed of a squirrel-cage induction motor can be controlled by all of the following except
(a) changing supply frequency
(b) changing number of poles

(c) changing winding resistance
(d) reducing supply voltage
Ans: c
40. The ‘crawling” in an induction motor is caused by
(a) high loads
(6) low voltage supply
(c) improper design of machine
(d) harmonics developed in the motor
Ans: d
41. The power factor of an induction motor under no-load conditions will be closer to
(a) 0.2 lagging
(b) 0.2 leading
(c) 0.5 leading
(d) unity
Ans: a
42. The ‘cogging’ of an induction motor can be avoided by
(a) proper ventilation
(b) using DOL starter
(c) auto-transformer starter
(d) having number of rotor slots more or less than the number of stator slots (not equal)
Ans: d
43. If an induction motor with certain ratio of rotor to stator slots, runs at 1/7 of the normal speed, the phenomenon will be termed as
(a) humming
(b) hunting
(c) crawling
(d) cogging
Ans: c
44. Slip of an induction motor is negative when
(a) magnetic field and rotor rotate in opposite direction
(b) rotor speed is less than the synchronous speed of the field and are in the same direction
(c) rotor speed is more than the synchronous speed of the field and are in the same

direction
(d) none of the above
Ans: c
45. Size of a high speed motor as compared to low speed motor for the same H.P. will be
(a) bigger
(b) smaller
(c) same
(d) any of the above
Ans: b
46. A 3-phase induction motor stator delta connected, is carrying full load and one of its fuses blows out. Then the motor
(a) will continue running burning its one phase
(b) will continue running burning its two phases
(c) will stop and carry heavy current causing permanent damage to its winding
(d) will continue running without any harm to the winding
Ans: a
47. A 3-phase induction motor delta connected is carrying too heavy load and one of its fuses blows out. Then the
motor
(a) will continue running burning its one phase
(b) will continue running burning its two phase
(c) will stop and carry heavy current causing permanent damage to its winding
(d) will continue running without any harm to the winding
Ans: c
48. Low voltage at motor terminals is due to
(a) inadequate motor wiring
(b) poorely regulated power supply
(c) any one of the above
(d) none of the above
Ans: c
49. In an induction motor the relationship between stator slots and rotor slots is that
(a) stator slots are equal to rotor slots
(b) stator slots are exact multiple of rotor slots
(c) stator slots are not exact multiple of rotor slots

(d) none of the above
Ans: c
50. Slip ring motor is recommended where
(a) speed control is required
(6) frequent starting, stopping and reversing is required
(c) high starting torque is needed
(d) all above features are required
Ans: d
51. As load on an induction motor goes on increasing
(a) its power factor goes on decreasing
(b) its power factor remains constant
(c) its power factor goes on increasing even after full load
(d) its power factor goes on increasing up to full load and then it falls again
Ans: d
52. If a 3-phase supply is given to the stator and rotor is short circuited rotor will move
(a) in the opposite direction as the direction of the rotating field
(b) in the same direction as the direction of the field
(c) in any direction depending upon phase squence of supply
Ans: b
53. It is advisable to avoid line starting of induction motor and use starter because
(a) it will run in reverse direction
(b) it will pick up very high speed and may go out of step
(c) motor takes five to seven times its full load current
(d) starting torque is very high
Ans: c
54. The speed characteristics of an induction motor closely resemble the speedload characteristics of which of the
following machines
(a) D.C. series motor
(b) D.C. shunt motor
(c) universal motor
(d) none of the above
Ans: b

55. Which type of bearing is provided in small induction motors to support the rotor shaft ?
(a) Ball bearings
(b) Cast iron bearings
(c) Bush bearings
(d) None of the above
Ans: a
56. A pump induction motor is switched on to a supply 30% lower than its rated voltage. The pump runs. What will
eventually happen ? It will
(a) stall after sometime
(b) stall immediately
(c) continue to run at lower speed without damage
(d) get heated and subsequently get damaged
Ans: d
57. 5 H.P., 50-Hz, 3-phase, 440 V, induction motors are available for the following r.p.m. Which motor will be the
costliest ?
(a) 730 r.p.m.
(b) 960 r.p.m.
(c) 1440 r.p.m.
(d) 2880 r.p.m.
Ans: a
58. A 3-phase slip ring motor has
(a) double cage rotor
(6) wound rotor
(c) short-circuited rotor
(d) any of the above
Ans: b
59. The starting torque of a 3-phase squirrel cage induction motor is
(a) twice the full load torque
(b) 1.5 times the full load torque
(c) equal to full load torque
Ans: b

60. Short-circuit test on an induction motor cannot be used to determine
(a) windage losses
(b) copper losses
(c) transformation ratio
(d) power scale of circle diagram
Ans: a
61. In a three-phase induction motor
(a) iron losses in stator will be negligible as compared to that in rotor
(6) iron losses in motor will be neg¬ligible as compared to that in rotor
(c) iron losses in stator will be less than that in rotor
(d) iron losses in stator will be more than that in rotor
Ans: d
62. In case of 3-phase induction motors, plugging means
(a) pulling the motor directly on line without a starter
(b) locking of rotor due to harmonics
(c) starting the motor on load which is more than the rated load
(d) interchanging two supply phases for quick stopping
Ans: d
63. Which is of the following data is required to draw the circle diagram for an induction motor ?
(a) Block rotor test only
(b) No load test only
(c) Block rotor test and no-load test
(d) Block rotor test, no-load test and stator resistance test
Ans: d
64. In three-phase induction motors sometimes copper bars are placed deep in the rotor to
(a) improve starting torque
(b) reduce copper losses
(c) improve efficiency
(d) improve power factor
Ans: a
65. In a three-phase induction motor
(a) power factor at starting is high as compared to that while running
(b) power factor at starting is low as compared to that while running

(c) power factor at starting in the same as that while running
Ans: b
66. The vafcie of transformation ratio of an induction motor can be found by
(a) open-circuit test only
(b) short-circuit test only
(c) stator resistance test
(d) none of the above
Ans: b
67. The power scale of circle diagram of an induction motor can be found from
(a) stator resistance test
(6) no-load test only
(c) short-circuit test only
(d) noue of the above
Ans: c
68. The shape of the torque/slip curve of induction motor is
(a) parabola
(b) hyperbola
(c) rectangular parabola
(d) straigth line
Ans: c
69. A change of 4% of supply voltage to an induction motor will produce a change of appromimately
(a) 4% in the rotor torque
(b) 8% in the rotor torque
(c) 12% in the rotor torque
(d) 16% in the rotor torque
Ans: d
70. The stating torque of the slip ring induction motor can be increased by adding
(a) external inductance to the rotor
(b) external resistance to the rotor
(c) external capacitance to the rotor
(d) both resistance and inductance to rotor
Ans: b
71. A 500 kW, 3-phase, 440 volts, 50 Hz, A.C. induction motor has a speed of 960 r.p.m. on full load. The machine has 6 poles. The slip of the machine will be

(a) 0.01
(b) 0.02
(c) 0.03
(d) 0.04
Ans: d
72. The complete circle diagram of induetion motor can be drawn with the help of data found from
(a) noload test
(6) blocked rotor test
(c) stator resistance test
(d) all of the above
Ans: d
73. In the squirrel-cage induction motor the rotor slots are usually given slight skew
(a) to reduce the magnetic hum and locking tendency of the rotor
(b) to increase the tensile strength of the rotor bars
(c) to ensure easy fabrication
(d) none of the above
Ans: a
74. The torque of a rotor in an induction motor under running condition is maximum
(a) at the unit value of slip
(b) at the zero value of slip
(c) at the value of the slip which makes rotor reactance per phase equal to the resistance per phase
(d) at the value of the slip which makes the rotor reactance half of the rotor
Ans: c
75. What will happen if the relative speed between the rotating flux of stator and rotor of the induction motor is zero ?
(a) The slip of the motor will be 5%
(b) The rotor will not run
(c) The rotor will run at very high speed
(d) The torque produced will be very large
Ans: b

76. The circle diagram for an induction motor cannot be used to determine
(a) efficiency
(b) power factor
(c) frequency
(d) output
Ans: a
77. Blocked rotor test on induction motors is used to find out
(a) leakage reactance
(b) power factor on short circuit
(c) short-circuit current under rated voltage
(d) all of the above
Ans: d
78. Lubricant used for ball bearing is usually
(a) graphite
(b) grease
(c) mineral oil
(d) molasses
Ans: b
79. An induction motor can run at synchronous speed when
(a) it is run on load
(b) it is run in reverse direction
(c) it is run on voltage higher than the rated voltage
(d) e.m.f. is injected in the rotor circuit
Ans: d
80. Which motor is preferred for use in mines where explosive gases exist ?
(a) Air motor
(b) Induction motor
(c) D.C. shunt motor
(d) Synchronous motor
Ans: a
81. The torque developed by a 3-phase induction motor least depends on
(a) rotor current
(b) rotor power factor
(c) rotor e.m.f.

(d) shaft diameter
Ans: d
82. In an induction motor if air-gap is increased
(a) the power factor will be low
(b) windage losses will be more
(c) bearing friction will reduce
(d) copper loss will reduce In an induction motor
Ans: a
83. In induction motor, percentage slip depends on
(a) supply frequency
(b) supply voltage
(c) copper losses in motor
(d) none of the above
Ans: c
84. When /?2 is the rotor resistance, .X2 the rotor reactance at supply frequency and s the slip, then the condition for maximum torque under running conditions will be
(a) sR2X2 = 1
(b) sR2 = X2
(c) R2 = sX2
(d) R2 = s2X2
Ans: c
85. In case of a double cage induction motor, the inner cage has
(a) high inductance arid low resistance
(b) low inductance and high resistance
(c) low inductance and low resistance
(d) high inductance and high resistance
Ans: a
86. The low power factor of induction motor is due to
(a) rotor leakage reactance
(b) stator reactance
(c) the reactive lagging magnetizing current necessary to generate the magnetic flux
(d) all of the above
Ans: d

87. Insertion of reactance in the rotor circuit
(a) reduces starting torque as well as maximum torque
(b) increases starting torque as well as maximum torque
(c) increases starting torque but maxi-mum torque remains unchanged
(d) increases starting torque but maxi-mum torque decreases
Ans: a
88. Insertion of resistance in the rotcir of an induction motor to develop a given torque
(a) decreases the rotor current
(b) increases the rotor current
(c) rotor current becomes zero
(d) rotor current rernains same
Ans: d
89. For driving high inertia loods best type of induction motor suggested is
(a) slip ring type
(b) squirrel cage type
(c) any of the above
(d) none of the above
Ans: a
90. Temperature of the stator winding of a three phase induction motor is obtained by
(a) resistance rise method
(b) thermometer method
(c) embedded temperature method
(d) all above methods
Ans: d
91. The purpose of using short-circuit gear is
(a) to short circuit the rotor at slip rings
(b) to short circuit the starting resistances in the starter
(c) to short circuit the stator phase of motor to form star
(d) none of the above
Ans: a
92. In a squirrel cage motor the induced e.m.f. is
(a) dependent on the shaft loading
(b) dependent on the number of slots

(c) slip times the stand still e.m.f. induced in the rotor
(d) none of the above
Ans: c
93. Less maintenance troubles are experienced in case of
(a) slip ring induction motor
(6) squirrel cage induction motor
(c) both (a) and (b)
(d) none of the above
Ans: b
94. A squirrel cage induction motor is not selected when
(a) initial cost is the main consideration
(b) maintenance cost is to be kept low
(c) higher starting torque is the main consideration
(d) all above considerations are involved
Ans: c
95. Reduced voltage starter can be used with
(a) slip ring motor only but not with squirrel cage induction motor
(b) squirrel cage induction motor only but not with slip ring motor
(c) squirrel cage as well as slip ring induction motor
(d) none of the above
Ans: c
96. Slip ring motor is preferred over squirrel cage induction motor where
(a) high starting torque is required
(b) load torque is heavy
(c) heavy pull out torque is required
(d) all of the above
Ans: a
97. In a star-delta starter of an induction motor
(a) resistance is inserted in the stator
(b) reduced voltage is applied to the stator
(c) resistance is inserted in the rotor
(d) applied voltage perl stator phase is 57.7% of the line voltage
Ans: d
98. The torque of an induction motor is
(a) directly proportional to slip

(b) inversely proportional to slip
(c) proportional to the square of the slip
(d) none of the above
Ans: a
99. The rotor of an induction motor runs at
(a) synchronous speed
(b) below synchronous speed
(c) above synchronous speed
(d) any of the above
Ans: b
100. The starting torque of a three phase induction motor can be increased by
(a) increasing slip
(b) increasing current
(c) both (a) and (b)
(d) none of the above
Ans: c
101. Insertion of resistance in the stator of an induction motor
(a) increases the load torque
(b) decreases the starting torque
(c) increases the starting torque
(d) none of the above
Ans: b

# NUMERICALS

**1. A three-phase 440 V, 6 pole, 50 Hz, squirrel cage induction motor is running at a slip of 5%. The speed of stator magnetic field with respect to rotor magnetic field and speed of rotor with respect to stator magnetic field are**

**2. the rotor of a three phase, 5 kW, 400 V, 50 Hz, slip ring induction motor is wound for 6 poles while its stator is wound for 4 poles. The approximate average no load steady state speed when this motor is connected to 400 V, 50 Hz supply is**

**3. If the full-load speed of a 6-phase, 50 Hz induction motor is 950 rpm, what is its half-load speed nearly equal to ?**

**4. A 6-pole, 50 Hz wound rotor induction motor when supplied at the rated voltage and frequency with slip-rings open circuited, developed a voltage of 100 V between any two slip rings. If the rotor is driven by an external means at 1,000 rpm opposite to the direction of stator field, the frequency of voltage across slip rings will be**

**5. An induction motor having 8 poles runs at 727.5 rpm. If the supply frequency is 50 Hz, the emf in the rotor will have a frequency of**

**6. A 6-pole, 3-phase alternator running at 1,000 rpm supplies to an 8-pole, 3-phase induction motor which has a rotor current of frequency 2 Hz. The speed at which the motor operates is**

**7. A voltmeter gives 120 oscillations per minute when connected to the rotor of an induction motor. The frequency is 50 Hz. The slip of the motor is**

**8. A centre zero ammeter connected in the rotor circuit of a 6-pole, 50 Hz induction motor makes 30 oscillations in one minute. The rotor speed is**

# SYNCHRONOUS MOTORS – Electrical Engineering

1. Synchronous motors are generally not self-starting because
(a) the direction of rotation is not fixed
(b) the direction of instantaneous torque reverses after half cycle
(c) startes cannot be used on these machines
(d) starting winding is not provided on the machines
Ans: b

2. In case one phase of a three-phase synchronous motor is short-circuited the motor will
(a) not start
(b) run at 2/3 of synchronous speed
(c) run with excessive vibrations
(d) take less than the rated load
Ans: a

3. A pony motor is basically a
(a) small induction motor
(b) D.C. series motor
(c) D.C. shunt motor
(d) double winding A.C./D.C. motor
Ans: a

4. A synchronous motor can develop synchronous torque
(a) when under loaded
(b) while over-excited
(c) only at synchronous speed
(d) below or above synchronous speed
Ans: c

5. A synchronous motor can be started by
(a) pony motor
(b) D.C. compound motor
(c) providing damper winding
(d) any of the above
Ans: d

6. A three-phase synchronous motor will have
(a) no slip-rings
(b) one slip-ring
(c) two slip-rings
(d) three slip-rings
Ans: c

7. Under which of the following conditions hunting of synchronous motor is likely to occur ?
(a) Periodic variation of load
(b) Over-excitation
(c) Over-loading for long periods
(d) Small and constant load
Ans: a

8. When the excitation of an unloaded salient pole synchronous motor suddenly gets disconnected
(a) the motor stops
(b) it runs as a reluctance motor at the same speed
(c) it runs as a reluctance motor at a lower speed
(d) none of the above
Ans: a

9. When V is the applied voltage, then the breakdown torque of a synchronous motor varies as
(a) V
(b) V312
(c) V2
(d) 1/V
Ans: a

10. The power developed by a synchronous motor will be maximum when the load angle is
(a) zero
(b) 45°
(c) 90°
(d) 120°
Ans: c

11. A synchronous motor can be used as a synchronous capacitor when it is
(a) under-loaded
(b) over-loaded
(c) under-excited
(d) over-excited
Ans: d

12. A synchronous motor is running on a load with normal excitation. Now if the load on the motor is increased
(a) power factor as well as armature current will decrease
(b) power factor as well as armature current will increase
(c) power factor will increase but armature current will decrease
(d) power factor will decrease and armature current will increase
Ans: d

13. Mostly, synchronous motors are of
(a) alternator type machines
(6) induction type machines
(c) salient pole type machines
(d) smooth cylindrical type machines
Ans: c

14. The synchronous motor is not inherently self-starting because
(a) the force required to accelerate the rotor to the synchronous speed in an instant is absent
(b) the starting device to accelerate the rotor to near synchronous speed is absent
(c) a rotating magnetic field does not have enough poles
(d) the rotating magnetic field is produced by only 50 Hz frequency currents
Ans: a

15. As the load is applied to a synchronous motor, the motor takes more armature current because
(a) the increased load has to take more current
(b) the rotor by shifting its phase backward causes motor to take more current
(c) the back e.m.f. decreases causing an increase in motor current
(d) the rotor strengthens the rotating field casuing more motor current
Ans: b

16. Synchronous motor always runs at
(a) the synchronous speed
(b) less than synchronous speed
(c) more than synchronous speed
(d) none of the above
Ans: a

17. An over-excited synchronous motor takes
(a) leading current
(b) lagging current
(c) both (a) and (b)
(d) none of the above
Ans: a

18. The working of a synchronous motor is similar to
(a) gear train arrangement
(b) transmission of mechancial power by shaft
(c) distribution transformer
(d) turbine
(e) none of the above
Ans: b

19. The minimum armature current of the synchronous motor corresponds to operation at

(a) zero power factor leading
(b) unity power factor
(c) 0.707 power factor lagging
(d) 0.707 power factor leading
Ans: b

20. In a synchronous motor, the magnitude of stator back e.m.f. £& depends on
(a) d.c. excitation only
(b) speed of the motor
(c) load on the motor
(d) both the speed and rotor flux
Ans: a

21. If load (or torque) angle of a 4-pole synchronous motor is 6° electrical, its value in mechanical degrees is
(a) 2
(b) 3
(c) 4
(d) 6
Ans: b

22. For V-curves for a synchronous motor the graph is drawn between
(a) field current and armature current
(b) terminal voltage and load factor
(c) power factor and field current
(d) armature current and power factor
Ans: a

23. The back e.m.f. of a synchronous motor depends on
(a) speed
(b) load
(c) load angle
(d) all of the above
Ans: c

24. A synchronous motor can operate at
(a) lagging power factor only
(6) leading power factor only
(c) unity power factor only
(d) lagging, leading and unity power factors
Ans: d

25. In a synchronous motor which loss varies with load ?
(a) Windage loss
(b) Bearing friction loss
(c) Copper loss

(d) Core loss
Ans: c

26. A synchronous motor can be made self starting by providing
(a) damper winding on rotor poles
(b) damper winding on stator
(c) damper winding on stator as well as rotor poles
(d) none of the above
Ans: d

27. The oscillations in a synchronous motor can be damped out by
(a) maintaining constant excitation
(b) running the motor on leading power factors
(c) providing damper bars in the rotor pole faces
(d) oscillations cannot be damped
Ans: c

28. The shaft of synchronous motor is made of
(a) mild steel
(b) chrome steel
(c) alnico
(d) stainless steel
Ans: a

29. When the field of a synchronous motor is under-excited, the power factor will be
(a) leading
(b) lagging
(c) unity
(d) zero
Ans: b

30. The speed regulation of a synchronous motor is always
(a) 1%
(b) 0.5%
(c) positive
(d) zero
Ans: d

31. The percentage slip in case of a synchronous motor is
(a) 1%
(b) 100%
(c) 0.5%
(d) zero
Ans: d

32. The operating speed of a synchronous motor can be changed to new fixed value by
(a) changing the load
(b) changing the supply voltage
(c) changing frequency
(d) using brakes
Ans: c

33. A synchronous motor will always stop when
(a) supply voltage fluctuates
(b) load in motor varies
(c) excitation winding gets disconnected
(d) supply voltage frequency changes9885859805
Ans: c

34. riunting in a synchronous motor takes place
(a) when supply voltage fluctuates
(b) when load varies
(c) when power factor is unity
(d) motor is under loaded
Ans: b

35. When load on an over-excited or under excited synchronous*motor is increased, rate of change of its armature current as compared with that of power factor is
(a) more
(b) less
(c) equal
(d) twice
Ans: b

36. The rotor copper losses, in a synchronous motor, are met by
(a) d.c. source
(b) armature input
(c) motor input
(d) supply lines
Ans: a

37. The maximum power developed in a synchronous motor occurs at a coupling angle of
(a) 30°
(b) 60°
(c) 90°
(d) 180°
Ans: c

38. When the stator windings are connected in such a fashion that the number of poles are made half, the speed of the rotor of a synchronous motor
(a) remains same as the original value
(b) decreases to half the original value
(c) tends to becomes zero
(d) increases to two times the original value
Ans: d

39. In which of the following motors the stator and rotor magnetic field rotate at the same speed ?
(a) Universal motor
(b) Synchronous motor
(c) Induction motor
(d) Reluctance motor
Ans: b

40. Synchronsizingpower of a synchronous machine is
(a) direcly proportional to the synchronous reactance
(6) inversely proportional to the synchronous reactance
(a) equal to the synchronous reactance
(d) none of the above
Ans: b

41. Synchronous motors are
(a) not-self starting
(b) self-starting
(c) essentially self-starting
(d) none of the above
Ans: a

42. The standard full-load power factor ratings for synchronous motors are
(a) zero or 0.8 leading
(b) unity or 0.8 lagging
(c) unity or 0.8 leading
(d) unity or zero
Ans: c

43. A synchronous motor running with normal excitation adjusts to load increases essentially by increase in
(a) back e.m.f.
(b) armature current
(c) power factor
(d) torque angle
Ans: b

44. A synchronous motor has better power factor as compared to that of an equivalent induction motor. This is mainly because

(a) synchronous motor has no slip
(b) stator supply is not required to produce magnetic field
(c) mechanical load on the rotor remains constant
(d) synchronous motor has large airgap
Ans: b

45. A synchronous motor working at leading power factor can be used as
(a) voltage booster
(b) phase advancer
(c) noise generator
(d) mechanical synchronizer
Ans: b

46. Slip rings are usually made of
(a) carbon or graphite
(b) brass or steel
(c) silver or gold
(d) copper or aluminium
Ans: b

47. An over excited synchronous motor is used for
(a) fluctuating loads
(b) variable speed loads
(c) low torque loads
(d) power factor corrections
Ans: d

48. When the voltage applied to a synchronous motor is increased, which of the following will reduce ?
(a) Stator flux
(b) Pull in torque
(c) Both (a) and (b)
(d) None of the above
Ans: d

51. The efficiency of a properly designed synchronous motor will usually fall in range
(a) 60 to 70%
(6) 75 to 80%
(c) 85 to 95%
(d) 99 to 99.5%
Ans: c

52. To limit the operating temperature an electrical machine should have proper
(a) voltage rating
(b) current rating
(c) power factor

(d) speed
Ans: b

53. Slip-rings in a synchronous motor carry
(a) direct current
(b) alternating current
(c) no current
(d) all of the above
Ans: a

54. A synchronous machine with large air gap has
(a) a higher value of stability limit
(6) a small value of inherent regulation
(c) a higher synchronizing power which makes the machine less sensitive to load variations
(d) all of the above
Ans: d

55. The armature current of the synchronous motor has higher values for
(a) high excitation only
(b) low excitation only
(c) both (a) and (b)
(d) none of the above
Ans: c

56. In a synchronous motor running with fixed excitation, when the load is increased three times, its torque angle becomes approximately
(a) one-third
(b) twice
(c) thrice
(d) six times
(e) nine times
Ans: c

57. The angle between the rotating stator flux and rotor poles is called _____ angle.
(a) torque
(b) obtuse
(c) synchronizing
(d) power factor
Ans: a

58. Which of the following methods is used to start a synchronous motor ?
(a) Damper winding
(b) Star-delta starter
(c) Damper winding in conjunction with star-delta starter

(d) Resistance starter in the armature circuit
Ans: c

59. When the rotor speed, in a synchronous machine, becomes more than the synchronous speed during hunting, the damper bars develop
(a) inductor motor torque
(b) induction generator torque
(c) synchronous motor torque
(d) d.c. motor toque
(e) none of the above
Ans: b

60. An important advantage of a synchronous motor over wound round induction motor is that
(a) its power factor may be varied at will
(b) its speed is independent of supply frequency
(c) its speed may be controlled more easily
(d) none of the above
Ans: a

61. The mechanical displacement of the rotor with respect to the stator, in polyphase multipolar synchronous motors running at full load, is of the order of
(a) zero degree
(b) two degrees
(c) five degrees
(d) ten degrees
Ans: c

62. Power factor of a synchronous motor is unity when
(a) the armature current is maximum
(b) the armature current is minimum
(c) the armature current is zero
(d) none of the above
Ans: b

63. Change of D.C. excitation of a synchronous motor changes
(a) applied voltage of the motor
(b) motor speed
(c) power factor of power drawn by the motor
(d) any of the above
(e) all of the above
Ans: c

64. While starting a synchronous motor by induction motor action, field winding is usually
(a) connected to D.C. supply
(b) short-circuited by low resistance

(c) kept open-circuited
(d) none of the above
Ans: b

65. Which of the following motors will be used in electric clocks ?
(a) D.C. shunt motor
(b) D.C. series motor
(c) A.C. induction motor
(d) A.C. synchronous motor
Ans: d

***SYNCHRONOUS MOTORS – Electrical Engineering Interview Questions and Answers***

66. If in a synchronous motor, driving mechanical load and drawing current at lagging power factor from constant voltage supply, its field excitation is increased, then its power factor
(a) become more
(b) become less
(c) remain constant
(d) none of the above
Ans: b

67. A synchronous motor installed at the receiving end substation operates with such an excitation that it takes power at lagging power factor. Now if the applied voltage of the synchronous motor goes down, the power factor of the synchronous motor will
(a) remain same
(b) go down
(c) improve
(d) none of the above
Ans: c

68. While starting a salient pole synchronous motor by induction motor action and connecting field discharge resistance across field, starting and accelerting torque is produced by
(a) induction motor torque in field winding
(b) induction motor torque in damper winding
(c) eddy current and hysteresis torque in pole faces
(d) reHetance motor torque due to saliency of the rotor
(e) all of the above methods
Ans: e

69. Armature of a synchronous machine is
(a) of reducing number of slip rings on the rotor
(b) armature is associated with large power as compared to the field circuits
(c) of difficulty of providing high voltage insulation on rotor

(d) all of the above reasons
Ans: d

70. If excitation of a synchronous motor running with a constant load is decreased from its normal value, ignoring effects of armature reaction, it leads to
(a) increase in both armature current and power factor angle
(b) increase in back e.m.f. but decrease in armature current
(c) increase in both armature current and power factor which is lagging
(d) increase in torque angle but decrease in back e.m.f.
Ans: a

71. When a 3-phase synchronous generator is supplying a zero power factor lagging load, the armature field affects the main field in the following way
(a) augments it directly
(b) directly opposes it
(c) cross-magnetises it
(d) none of the above
Ans: b

72. Stability of a synchronous machine
(a) decreases with increase in its excitation
(b) increases with increase in its excitation
(c) remains unaffected with increase in excitation
(d) any of the above
Ans: b

73. The power factor of a synchronous motor is better than that of induction motor because
(a) stator supply is relieved of responsibility of producing magnetic field
(b) mechanical load on the motor can be adjusted
(c) synchronous motor runs at synchronous speed
(d) synchronous motor has large air gap
Ans: a

74. If in a synchronous motor, driving a given mechanical load and drawing current at a leading power factor from constant voltage supply its field excitation is increased, its power factor
(a) will become more
(b) will become less
(c) will remain unchanged
(d) none of the above.
Ans: b

75. A synchronous motor is running with normal excitation. When the load is increased, the armature current drawn by it increases because
(a) speed of the motor is reduced
(b) power factor is decreased

(c) Eb (back e.m.f.) becomes less than V (applied voltage)
(d) Er (net resultant voltage) in armature is increased
(e) none of the above
Ans: d

76. If one-phase of a 3-phase synchronous motor is short-circuited, motor
(a) will refuse to start
(b) will overheat in spots
(c) will not come upto speed
(d) will fail to pull into step
Ans: a

77. If the field circuit of an unloaded salientpole synchronous motor gets suddenly open-circuited, then
(a) it runs at a slower speed
(b) the motor stops
(c) it continues to run at the same speed
(d) it runs at a very high speed
Ans: b

78. In which of the following motors the stator and rotor fields rotate simultaneously ?
(a) D.C. motor
(b) Reluctance motor
(c) Universal motor
(d) Synchronous motor
(e) Induction motor
Ans: d

79. The speed of a synchronous motor
(a) increases as the load increases
(b) decreases as the load decreases
(c) always remains constant
(d) none of the above
Ans: c

80. A rotory converter can also be run as a
(a) d.c. shunt motor
(b) d.c. series motor
(c) d.c. compound motor
(d) induction motor
(e) synchronous motor
Ans: e

81. The maximum speed variation in a 3-phase synchronous motor is
(a) 10 per cent
(b) 6 per cent

(c) 4 per cent
(d) 2. per cent
(e) zero
Ans: e

82. Which of the following resistances can be measured by conducting insulation resistance test on a synchronous motor ?
(a) Phase to phase winding resistance
(b) Stator winding to earthed frame
(c) Rotor winding to earthed shaft
(d) All of the above
Ans: d

83. Due to which of the following reasons a synchronous motor fails to pull into synchronism after applying D.C. field current ?
(a) High field current
(b) Low short circuit ratio
(c) High core losses
(d) Low field current
Ans: d

16.84. In a synchronous motor, the maximum power developed depends on all of the following except
(a) rotor excitation
(b) maximum value of coupling angle
(c) direction of rotation
(d) supply voltage
Ans: c

85. In a 3-phase synchronous motor, the negative phase sequence exists when the motor is
(a) supplied with unbalanced voltage
(b) under-loaded
(c) over-loaded
(d) none of the above
Ans: a

86. In a synchronous motor, damper windings are provided on
(a) stator frame
(b) rotor shaft
(c) pole faces
(d) none of the above
Ans: c

87. The induced e.m.f. in a synchronous motor working on leading power factor will be
(a) more than the supply voltage

(b) less than the supply voltage
(c) equal to the supply voltage
Ans: a

88. The effect of increasing the load on a synchronous motor running with normal excitation is to
(a) decrease both armature current and power factor
(6) decrease armature current but increase power factor
(c) increase armature current but decrease power factor
(d) increase both its armature current and power factor
Ans: c

89. The net armature voltage of a synchronous motor is equal to the
(a) vector sum of Eb and V
(b) arithmetic sum of Eb and V
(c) arithmetic difference of Eb and V
(d) vector difference of Eh and V
Ans: d

90. The ratio of starting torque to running torque in a synchronous motor is
(a) zero
(b) one
(c) two
(d) infinity
Ans: a

91. In a synchronous motor, the magnitude of stator back e.m.f. Eb depends on
(a) load on the motor
(b) d.c. excitation only
(c) both the speed and rotor flux
(d) none of the above
Ans: b

92. A 3-phase synchronous motor is running clockwise. If the direction of its field current is reversed
(a) the motor will stop
(b) the motor continue to run in the same direction
(c) the winding of the motor will burn
(d) the motor will run in the reverse direction
(e) none of the above
Ans: b

93. The magnitude of field flux in a 3-phase synchronous motor
(a) remains constant at all loads
(b) varies with speed
(c) varies with the load

(d) varies with power factor
Ans: a

94. The torque angle, in a synchronous motor, is the angle between
(a) the supply voltage and the back e.m.f.
(b) magnetising current and back e.m.f.
(c) the rotating stator flux and rotor poles
(d) none of the above
Ans: c

95. Hunting in a synchronous motor cannot be due to
(a) windage friction
(b) variable load
(c) variable frequency
(d) variable supply voltage
Ans: a

96. By which of the following methods the constant speed of a synchronous motor can be changed to new fixed value ?
(a) By changing the supply frequency
(b) By interchanging any two phases
(c) By changing the applied voltage
(d) By changing the load.
Ans: a

97. In a synchronous motor, V-curves represent relation between
(a) armature current and field current
(b) power factor and speed
(c) field current and speed
(d) field current and power factor
Ans: a

98. In a 3-phase, 4-pole, 50 Hz synchronous motor, the frequency, pole number and load torque all are halved. The motor speed will be
(a) 3000 r.p.m.
(b) 1500 r.p.m.
(c) 750 r.p.m.
(d) none of the above
Ans: b

99. A synchronous motor connected to infinite bus-bars has at constant full load, 100% excitation and unity power factor. On changing the excitation only, the armature current will have
(a) no change of power factor
(b) lagging power factor with over-excitation
(c) leading power factor with under-excitation

(d) leading power factor with over-excitation
Ans: d

100. Which of the following motors is non-self starting ?
(a) D.C. series motor
(b) synchronous motor
(c) Squirrel cage induction motor
(d) Wound round induction motor
Ans: b

101. In a synchronous motor it the back e.m.f. generated in the armature at noload is approximately equal to the applied voltage, then
(a) the motor is said to be fully loaded
(b) the torque generated is maximum
(c) the excitation is said to be zero per cent
(d) the excitation is said to be hundred per cent
Ans: d

102. In a synchronous motor, the damping winding is generally used to
(a) prevent hunting and provide the starting torque
(b) reduce the eddy currents
(c) provide starting torque only
(d) reduce noise level
(e) none of the above
Ans: a

103. If the field of a synchronous motor is underexcited, the power factor will be
(a) zero
(b) unity
(c) lagging
(d) leading
Ans: c

104. The back e.m.f. in the stator of a synchronous motor depends on
(a) number of poles
(b) flux density
(c) rotor speed
(d) rotor excitation
(e) none of the above
Ans: d

105. The maximum value of torque that a synchronous motor can develop without losing its synchronism, is known as
(a) slip torque
(b) pull-out torque
(c) breaking torque

(d) synchronising torque
Ans: d

106. In a synchronous motor, the armature current has large values for
(a) high excitation only
(b) low excitation only
(c) both high and low excitation
(d) none of the above
Ans: c

107. Which of the following losses, in a synchronous motor, does not vary with load?
(a) Windage loss
(b) Copper losses
(c) Any of the above
(d) None of the above
Ans: a

108. The size of a synchronous motor decreases with the increase in
(a) flux density
(b) horse power rating
(c) speed
(d) all of the above
Ans: a

109. Which of the following losses is not dissipated by the stator core surface in a synchronous motor ?
(a) Eddy current losses in the conductors
(b) Iron losses in the stator
(c) Copper losses in the slot portion of the conductors
(d) Windage losses
(e) None of the above
Ans: d

110. The duration of sudden snort-circuit test on a synchronous motor is usually about
(a) one hour
(b) one minute
(c) one second
(d) none of the above
Ans: c

111. The maximum constant load torque under which a synchronous motor will pull into synchronism at rated rotor supply voltage and frequency is known as
(a) pull-up torque
(b) pull-in torque
(c) pull-out torque

(d) none of the above
Ans: b

112. A synchronous machine with low value of short-circuit ratio has
(a) lower stability limit
(6) high stability limit
(c) good speed regulation
(d) good voltage regulation
(e) none of the above
Ans: a

113. The construction of a synchronous motor resembles
(a) a series motor
(b) an induction motor
(c) an alternator
(d) a rotary converter
Ans: c

114. If the field winding of an unloaded salient pole synchronous motor is open circuited, the motor will
(a) stop
(b) run as induction motor
(c) function as static condenser
(d) burn with dense smoke
Ans: a

115. For power factor correction, synchronous motors operate at
(a) no-load and greatly over-excited fields
(b) no-load and under-excited fields
(c) normal load with minimum excitation
(d) normal load with zero excitation
Ans: a

116. The maximum torque which a synchronous motor will develop at rest for any angular position of the rotor, at rated stator supply voltage and frequency, is known as
(a) locked-rotor torque
(b) synchronous torque
(c) pull up torque
(d) reluctance torque
Ans: a

117. Exciters of synchronous machines are
(a) d.c. shunt machines
(b) d.c. series machines
(c) d.c. compound machines

(d) any of the above
Ans: a

118. The coupling angle or load angle of synchronous motor is defined as the angle between the
(a) rotor and stator teeth
(b) rotor and the stator poles of opposite polarity
(c) rotor and the stator poles of the same polarity
(d) none of the above
Ans: b

119. If the synchronous motor, properly synchronised to the supply is running on no load and is having negligible loss
then
(a) the stator current will be zero
(b) the stator current will be very small
(c) the stator current will be very high
(d) the back e.m.f. will be more than the supply voltage
(e) none of the above
Ans: a

120 The armature current of the synchronous motor
(a) has large values for low excitation i niy
(b) has large values for high excitation only
(c) has large values for low and high excitation
(d) any of the above
Ans: c

121. The maximum power developed in a synchronous motor will depend on
(a) the rotor excitation only
(b) the supply voltage only
(c) the rotor excitation and supply volt-age both
(d) the rotor excitation, supply voltage and maximum value of coupling angle (90°)
(e) none of the above
Ans: d

122. A synchronous motor which works on a leading power factor and does not drive a mechanical load is called as
(a) static condenser
(b) condenser
(c) synchronous condenser
(d) none of the above
Ans: c

129. A synchronous motor develops maximum power when load angle is
(a) 45°

(b) 60°
(c) 90°
(d) 120°
Ans: c

130. In a synchronous motor, the breakdown torque is
(a) directly proportional to applied voltage
(b) directly proportional to the square of the applied voltage
(c) inversely proportional to applied voltage
(d) none of the above
Ans: a

# QUESTION BANK

## ENERGY CONVERSION-II

### UNIT-I
### ALTERNATOR

**1. Why a 3-phase synchronous motor will always run at synchronous speed?**

Because of the magnetic coupling between the stator poles and rotor poles the motor runs exactly at synchronous speed.

**2. What are the two classification synchronous machines?**

The classification synchronous machines are:

i. Cylindrical rotor type
ii. Salient pole rotor type

**3. What are the essential features of synchronous machine?**

i. The rotor speed is synchronous with stator rotating field.
ii. Varying its field current can easily vary the speed.
iii. It is used for constant speed operation.

**4. Mention the methods of starting of 3-phase synchronous motor.**

a. A D.C motor coupled to the synchronous motor shaft.
b. A small induction motor coupled to its shaft. (Pony method)
c. Using damper windings –started as a squirrel cage induction motor.

**5. What are the principal advantages of rotating field system type of construction of synchronous machines?**

- Form Stationary connection between external circuit and system of conditions enable the machine to handle large amount of volt-ampere as high as 500 MVA.
- The relatively small amount of power required for field system can be easily supplied to the rotating field system via slip rings and brushes.
- More space is available in the stator part of the machine for providing more insulation to the system of conductors.
- Insulation to stationary system of conductors is not subjected to mechanical stresses due to centrifugal action.

**6. Write down the equation for frequency of emf induced in an alternator.**

F = PN / 120 Hertz

Where P = No. Of poles

N = Speed in rpm.

**7. What are the advantages of salient pole type of construction used for synchronous machines?**

- They allow better ventilation.
- The pole faces are so shaped radial air gap length increases from the pole center to the pole tips so that flux distribution in the air gap is sinusoidal in shape which will help to generate sinusoidal emf.
- Due the variable reluctance, the machine develops additional reluctance power, which is independent of excitation.

**8. Why do cylindrical rotor alternators operate with steam turbines?**

Steam turbines are found to operate at fairly good efficiency only at high speeds. The high-speed operation of rotor tends to increase mechanical losses, so the rotors should have smooth external surface. Hence smooth cylindrical type rotors with less diameter and large axial length are used for synchronous generators driven by steam turbines with either 2 or 4 poles.

**9. Which type of synchronous generators are used in Hydroelectric plants and why?**

As the speed of operation is low, for hydro turbines used in hydroelectric plants, salient pole type synchronous generators are used. These allow better ventilation and also have other advantages over smooth cylindrical type rotor.

**10. What is the relation between electrical degree and mechanical degree?**

Electrical degree $\theta_e$ and mechanical degree are related to one another by the number of poles P, the electrical machine has, as given by the following equation.

$\theta_e = (P/2)\ \theta_m$

**11. What is the meaning of electrical degree?**

Electrical degree is used to account the angle between two points in rotating electrical machines. Since all electrical machines operate with the help of magnetic fields, the electrical degree is accounted with reference to the polarity of magnetic fields. 180 electrical degrees is accounted as the angle between adjacent North and South poles

**12. Why short-pitch winding is preferred over full pitch winding?**

**Advantages: -**

- Waveform of the emf can be approximately made to a sine wave and distorting harmonics can be reduced or totally eliminated.
- Conductor material, copper is saved in the back and front-end connections due to less coil span.
- Fractional slot winding with fractional number of slots/phase can be used which in turn reduces the tooth ripples.
- Mechanical strength of the coil is increased.

**13. Write down the formula for distribution factor.**

$$K_d = \frac{\sin(m\beta/2)}{m\sin(\beta/2)}$$

m - number of slots/pole/phase

β - angle between adjacent slots in electrical degree n - order of harmonics.

**14. Define winding factor.**

The winding factor $K_w$ is defined as the ratio of phasor addition of emf induced in all the coils belonging to each phase winding of their arithmetic addition.

**15. Why are alternators rated in kVA and not in kW?**

The continuous power rating of any machine is generally defined as the power the machine or apparatus can deliver for a continuous period so that the losses incurred in the machine gives rise to a steady temperature rise not exceeding the limit prescribed by the insulation class.

Apart from the constant loss the variable loss incurred in alternators is the copper loss, occurring in the 3-phase winding, which depends on $I^2R$, the square of the current delivered by the generator. is directly related to apparent power delivered by the generator,Thusthe alternators have only their apparent power in VA/kVA/MVA as their power rating.

**16. What are the causes of changes in voltage of alternators when loaded?**

- Voltage variation due to the resistance of the winding R.
- Voltage variation due to the leakage reactance of the winding $X_1$.
- Voltage variation due to the armature reaction.

**17. What is meant by armature reaction in alternators?**

The interaction between flux set up by the current carrying armature conductors and the main field flux is defined as the armature reaction.

**18. What do you mean by synchronous reactance?**

It is the sum of the leakage reactance $X_1$ and armature reactance $X_a$

$$X_s = X_1 + X_a$$

**19. What is effective resistant [$R_{eff}$]?**

The apparent increase in resistance of the conductor when an alternating current is flowing through it is known as effective resistance.

**20. What is synchronous impedance?**

The complex addition of resistance R and synchronous reactance $jX_s$ is synchronous impedance $Z_s$.

$$Z_s = (R+jX_s) = Z_s \angle \theta$$

Where $\theta = \tan^{-1}(X_s/R)$

$$|Z_s| = \sqrt{(R^2+jX_s^2)}$$

**21. What is meant by load angle of an alternator?**

The phase angle introduced between the induced emf phasor E and terminal voltage phasor V during the load condition of an alternator is called load angle. The load angle increases with increase in load. It is positive during generator operation and negative during motoroperation.

**22. Define the term voltage regulation of alternator.**

It is defined as the change in terminal voltage from no load-to-load condition expressed as a function or terminal voltage at load condition, the speed and excitation conditions remaining same.

% Regulation = (E-V)/V x 100

**23. What is the necessity for predetermination of voltage regulation?**

Most of the alternators are manufactured with large power rating and large voltage ratings. Conduction load test is not possible for such alternators. Hence other indirect methods oftesting are used and the performance can be predetermined at any desired load currents and power factors.

**24. Why is the synchronous impedance method of estimating voltage regulationis considered as pessimistic method?**

Compared to other methods, the value of voltage regulation obtained by this method is always higher than the actual value and therefore is called pessimistic method.

**25. Why is the MMF method of estimating the voltage regulation is considered asthe optimization method?**

Compared to EMF method, MMF method involves more number of complex calculation steps. Further the OCC is referred twice and SCC is referred once while predetermining the voltage regulation for each load condition. Reference of OCC takes core saturation effect. Asthis method requires more effort, the final result is very close to the actual value. Hence this method is called the optimistic method.

## LONG QUESTION

1. Describe with neat sketches the constructional details of a salient pole type alternator.
2. Draw a neat sketch showing the various parts of a synchronous machine. State the type of synchronous generator used in nuclear power stations.
3. Discuss briefly the load charactertics of alternator for different power factor.
4. Explain any one method of predetermining the regulation of an alternator.
5. Explain why the potier reactance is slightly higher than leakages reactance.
6. Explain dark lamp method of synchronizing an alternator with the bus bar.
7. Explain Blondel's two-reaction theory,
8. Explain how will you determine the d and q axes reactance of a synchronous machine in your laboratory.
9. Derive an expression for synchronizing power.
10. For a salient pole synchronous machine, derive an expression for power developed as a function of load angle.
11. Explain the operating principle of three-phase alternator.

## DEPARTMENT OF EE/ Electrical Machines-II/ III YEAR

## UNIT-II

## SYNCHRONOUS-MOTOR

**1. What does hunting of synchronous motor mean?**

When the load applied to the synchronous motor is suddenly increased or decreased, the rotor oscillates about its synchronous position with respect to the stator field. This action is called hunting.

**2. What could be the reasons if a 3-phase synchronous motor fails to start?**

It is usually due to the following reasons

a. Voltage may be too low.

b. Too much starting load.

c. Open circuit in one phase or short circuit.

d. Field excitation may be excessive

**3. What is synchronous condenser?**

An over-excited synchronous motor under no load ,used for the improvement of power factor is called as synchronous condenser because, like a capacitor it takes a leading current.

**4. Write the applications of synchronous motor.**

a. Used for power factor improvement in sub-stations and in industries.

b. Used in industries for power applications.

c. Used for constant speed drives such as motor-generator set, pumps and compressors.

**5. What is an inverted 'V' curve?**

For a constant load, if the power factor is plotted against various values of field exciting current, the curve formed is inverted V Shape and called as inverted 'V' curve.

**6. A synchronous motor starts as usual but fails to develop its full torque. What could it be due to?**

a. Exciter voltage may be too low.

b. Field spool may be reversed.

**7. What are the two types of 3-phase induction motor?**

a. Squirrel cage induction motor.
b. Slip ring induction motor.

**8. Write the two extra features of slip ring induction motors.**

a. Rotor is having 3-phase winding.
b. Extra resistance can be added in the rotor circuit by connecting through the help of three slip rings for improving the power factor, increasing Starting Torque, limiting the starting current.

**9. Can we add extra resistance in series with squirrel cage rotor? State the reason?**

We cannot add extra resistance in series with the rotor because all the copper bars of the rotor are short circuited in both the sides by copper end rings to have a closed circuit.

**10. Why an induction motor is called rotating transformer?**

The rotor receives electrical power in exactly the same way as the secondary of a two winding transformer receiving its power from primary. That is why an induction motor can be called as a rotating transformer i.e., in which primary winding is stationary but the secondary is free to rotate.

**11. Why an induction motor will never run at its synchronous speed?**

If it runs at synchronous speed then there would be no related speed between the two, hence no rotor emf, no rotor current so no rotor torques to maintain rotation. That is why the rotor runs at its synchronous speed.

**12. Define SCR?**

Short circuit ratio (SCR) is defined as the ratio of field current required to produce rated voltage on open-circuit to field current required to produce rated armature current with the terminals shorted, while the machine runs at synchronous speed.

**13. Why is open circuit charactertics called magnetic charactertic?**

The OCC is called magnetic charactertic because it gives the variation of space component of flux in air gap and mmf / pole of magnetic circuit.

**14. What are the losses determined from SCC?**

i. Copper loss
ii. Mechanical loss

**15. What are stray load losses?**

Stray load loss is the sum of load core loss and loss due to the additional conductor resistance offered to the ac.

**16. What is synchronizing?**

The operation of connecting an alternator in parallel with another alternator or with common bus bars is known as synchronizing.

**17. What is a synchroscope?**

Synchroscope is an instrument, which shows the phase relationship of emf of the incoming alternator. It also indicates whether the incoming alternator is running slow or fast.

**18. What is direct axis?**

The mmf wave is height when it is aligned with the field pole axis called the direct axis or d axis.

**19. What is quadrature axis?**

The permeance offered to a mmf wave is lower when it is oriented $90^o$

To the field pole axis called the quadrature axis or q axis.

**20. What are the two curves required for POTIER method?**

i. No load curve.
ii. Full load zero power factor curve called wattless load charactertic.

**21. What are the three methods of determining voltage regulation?**

i. Synchronous impedance method or EMF method.
ii. The ampere-turn or MMF method.
iii. Zero power factor or potier method.

**22. When does a synchronous motor get over excited?**

If the field excitation of the motor is increased, the field flux will become strong and $E_b$ will increase. As a result $E_b$ will exceed V and the motor will be called an over excited motor.

**23. Define pullout torque?**

The pullout torque is the torque, beyond which the synchronous link between field poles and resultant flux wave is severed and the machine falls out-of-slip.

**24. What is the main advantage of POTIER method?**

The voltage regulation calculated by potier's method is quite accurate.

**25. What is meant by the subtransient period?**

The initial period of decay of the short circuit current is called the subtransient, in which the current decay is governed mainly by the damper winding constant.

**26. What is fractional pitch winding?**

When a winding is made with coil span less than full pitch, the winding is called as fractional pitch winding.

## LONG QUESTION

1. Explain why a synchronous motor does not have starting torque.
2. Explain one method of starting a synchronous motor.
3. Why does the power factor of industrial installation tend to be low? How can it be improved?
4. Does the change in excitation affect the p.f of the synchronous motor?
5. An over excited synchronous motor is called a synchronous condenser. Explain.
6. Mention some specific applications of synchronous motor.
7. Explain what happens when the load on a synchronous motor is changed.
8. What is meant by constant power circle for synchronous motor?
9. What is meant by hunting in a synchronous motor? Why is it undesirable? What is done to minimize it?
10. Explain V-curves and inverted V-curves.
11. Draw the power angle diagram of a synchronous machine.
12. Explain briefly the principle of operation of three-phase synchronous motor.
13. Describe the effect of varying the excitation on the armature current and power factor of a synchronous motor when input power to the motor is maintained constant.

## UNIT-III
## THREE PHASE INDUCTION MOTOR

1. **What are types of 3- phase induction motor?**
   i. Squirrel cage induction motor
   ii. Slip ring induction motor

2. **Why the rotor slots of a 3-phase induction motor are skewed?**

The rotor slots of a three -phase induction motor are skewed

i. to make the motor run quietly by reducing the magnetic hum
ii. to reduce the locking tendency of the rotor

3. **Why the induction motor is called asynchronous motor?**

Since the induction motor runs always at a speed lesser than synchronous speed, it is called asynchronous motor.

4. **What are slip rings?**

The slip rings are made of copper alloys and are fixed around the shaft insulating it. Through these slip rings and brushes the rotor winding can be connected to external circuits.

5. **State the difference between slip ring rotor and cage rotor of an induction motor?**

Slip ring rotor has 3-phase windings. Three ends of which are stared and the other three ends are brought up and connected to 3 slip rings mounted in the shaft. Extra resistance can be added in the rotor circuit. Squirrel cage rotor has short-circuited copper bars. Extra resistance can't be added as slip ring rotor.

6. **Write an expression for the slip of an induction motor.**

Percentage slip = $(N_s - N_r) / N_s * 100$.

7. **What is cogging of an induction motor?**

When the number of stator and rotor teeth's is equal o r integral multiple of rotor teeth ,they have a tendency to align themselves exactly to minimum reluctance position. Thus the rotor may refuse to accelerate. This phenomenon is known as cogging.

8. **Explain why the no load current of an induction motor is much higher than that of an equivalent transformer.**

In induction motor, due to the presence of the air gap, the magnetizing current that is required to set up the flux is much higher. The working component of the current has to meet the hysteresis loss, eddy current loss, friction and windage losses. Hence the no load current of induction motor is higher.

9. **State the effect of rotor resistance on starting torque?**

Starting torque increases with increase in value of rotor resistance.

10. **What are the advantages of cage motor?**

- Since the rotor has very low resistance, the copper loss is low and efficiency is high
- On the account of simple construction of rotor, it is mechanically robust.
- Initial cost is less.
- Maintenance cost is less.
- Simple stating arrangement

11. **Give the conditions for maximum torque for 3-phase induction motor?**

The rotor resistance and rotor reactance should be equal for developing maximum torque i.e. $R_2 = s X_2$ where s is the slip –under running conditions.

$R_2 = X2$ under starting conditions

12. **What is reason for inserting additional resistance in rotor circuit of a slip ring induction motor?**

Introduction of additional resistance in the rotor circuit will increase the starting torque as well as running torque. Also it limits the starting current, improves the power factor.

13. **List out the methods of speed control of cage type 3-phase induction motor?**

a) By changing supply frequency

b) By changing the number of poles

c) By operating two motors in cascade

14. **Mention different types of speed control of slip ring induction motor?**

a) By changing supply frequency
b) By changing the number of stator poles
c) By rotor rheostat control
d) By operating two motors in cascade

**15. What are the advantages of 3-phase induction motor?**

a) It was very simple and extremely rugged, almost unbreakable construction
b) Its cost is very low and it is very reliable
c) It has been suffiently high efficiency .No brushes are needed and hence frictional losses are reduced
d) It requires minimum of maintenance.

**16. What does crawling of induction motor mean?**

Squirrel cage type, sometimes exhibit a tendency to run stably at speeds as low as 1/7 the of their synchronous speed, because of the harmonics this phenomenon is known as crawling

**17. State the application of an induction generator?**

a) Used in windmill for generating electric power.
b) Used in regenerative breaking places like traction.

**18. Name the two windings of a single-phase induction motor.**

I. Running winding
ii. Starting
winding.

**19. What are the various methods available for making a single-phase motor self-starting?**

i. By splitting the single phase into 2 phases
ii. By providing shading coil in the poles.

**20. What is the function of capacitor in a single-phase induction motor?**

I. To make more phase difference between the starting and running winding. ii. To improve the power factor and to get more torque.

**21. Give the names of three different types of single-phase motor.**

i. Split phase motor
ii. Shaded pole motor.
iii. Single phase series motor.
iv. Repulsion motor.

**22. What is the use of shading ring in a pole motor?**

The shading coil causes the flux in the shaded portion to lag behind the flux in unshaded portion of pole. This gives in effect a rotation of flux across the pole face and under the influence of this moving flux a stating torque is developed.

**23. State any four use of single-phase induction motor.**

Fans, Wet grinders, Vacuum cleaners, small pumps, compressors,drills

**24. Why is the efficiency of a 3-phase induction motor less than of a transformer?**

In induction motor, there is a mechanical loss due to the rotation of the rotor. Hence the efficiency of an induction motor is less than that of the transformer.

**25. What are the types of starters?**

Stator rheostat, Autotransformer and Star to Delta switch Rotor resistance starter.

## Long Questions:

1. Develop the equivalent circuit for 3-phase induction motor?
2. Explain the different speed control methods of squirrel cage induction motor.
3. Describe the principle of operation of synchronous induction motor.
4. Explain any one method of speed control of three- phase induction motor
5. Draw the slip-torque charactertics for a three-phase induction motor and explain.
6. Explain how a rotating magnetic field is produced in a three-phase induction motor.
7. Draw and explain the equivalent circuit of a three-phase induction motor. Apr: 2000
8. Describe with a neat diagram, the principle of operation of induction generator Oct: 2000
9. Draw and explain the torque/slip curves of a three-phase induction motor for different values of rotor resistance. Oct: 2000
10. Starting from the first principles, develop the equivalent circuit of a 3- phase induction motor.
11. Explain the procedure of drawing the circle diagram of an induction motor. How is the performance character tics obtained from it? Apr: 2001
12. Explain the operation of induction generator. Oct: 2001

**1. What are the types of starters?**

Stator rheostat, Autotransformer Star to Delta starter and rotor resistance starter.

**2. List out the methods of speed control of cage type 3-phase induction motor?**

a) By changing supply frequency
b) By changing the number of poles
c) By operating two motors in cascade

**3. Mention different types of speed control of slip ring induction motor?**

e) By changing supply frequency
f) By changing the number of stator poles
g) By rotor rheostat control
h) By operating two motors in cascade

**4. State the advantages of capacitor start run motor over capacitor start motor.**

Running torque is more; Power factor during running is more.

**5. What is Universal motor?**

A Universal motor is defined as a motor, which may be operated either on direct current or single-phase ac supply.

**6. State some application of universal motor.**

Used for sewing machines, table fans, Vaccum cleaners, hair driers, blowers etc

**7. Explain why single-phase induction motor is not self-starting one.**

When the motor is fed from a single phase supply its stator winding produces an alternating or pulsating flux, which develops no torque which is explained in Double revolving field theory.

**8. What type of motor is used for ceiling fan**?

Capacitor start and capacitor run single-phase motor is used for ceiling fans.

**9. What is the type of induction motor used in wet grinders**?

Capacitor start capacitor run single-phase induction motor.

**10. What kind of motor is used in mixie?**

Single-phase ac series motor is used in mixie.

**11. what is the application of shaded pole induction motor**?

Because of its small starting torque, it is generally used for small fans, toys, instruments, hair driers, ventilators, electric clock etc.

**12. In which direction does a shaded pole motor run**?

The rotor starts rotation in the direction from unshaded part to the shaded part.

**13. why single-phase induction motor has low power factor?**

The current through the running winding lags behind the supply voltage by a very large angle. Therefore power factor is very low.

**14. Diffrentiate between "capacitor start "and "capacitor start capacitor run "induction motor?**

In capacitor start motor, capacitor is connected in series with the starting winding. But it will be disconnected fro m the supply, when the motor picks up its speed. But in capacitor start capacitor run motor the above starting winding and capacitor are not disconnected, but always connected in the supply .so it has high starting and running torque.

**15. State the application of an induction generator?**

- Used in windmill for generating electric power.
- Used in regenerative breaking places like traction.

**16. What do you mean by residual EMF in a generator.**

The EMF induced in the armature conductor only due to the residual flux in the field poles is known as residual EMF

**17. State the effect of rotor resistance on starting torque?**

Starting torque increases with increase in value of rotor resistance.

**18. How can varying supply frequency control speed?**

We know that

$$Ns = \frac{120f}{P}$$

From the equation it is clear that by varying frequency speed can be varied it is very rarely.

**19. How is speed control achieved by changing the number of stator poles?**

Here change in stator poles is achieved by having two or more independent stator windings in the same slot. Each winding gives different number of poles and different speeds. At a time only one winding is used and other is closed

**20. What are the main disadvantages of rotor rheostatic control?**

- The speed can be decreased by increasing the rotor resistance, but increases $I^2R$ loss and hence decreases efficiency.
- Speed depends on load also and so used for small periods only.

**21. What are the methods of speed control preferred for large motors?**

- Kramer system
- Scherbius system

**22. What is an induction regulator?**

An induction regulator is used to obtain the constant voltage at the feeder end. Varying the range between the magnetic axes of the primary and secondary windings controls the voltage; it may be a single phase. Rotor is moved usually by a maximum of 180 degree.

**23. Define-Slip frequency.**

The relation motion of the stator flux and the rotor conductors induces the voltage offrequency $S_f$ called slip frequency.

**24. Define- Asynchronous torque.**

When stator and rotor fields are stationary with respect to each other, a steady torque is produced and rotation is maintained. Such a torque existing at any mechanical speed other than synchronous speed is called as an asynchronous torque.

**25. What is the main use of squirrel cage winding in synchronous motor starting?**

When a squirrel cage winding called the amortissuer or damper winding is inserted inthe rotor pole faces, the rotor comes up to the synchronous speed by induction motor actionwith the field winding unexcited.

**26. What is breakdown torque?**

From the torque verses slip charactertics, we can infer that as the torque increases, slip increases upto a maximum torque developed is called a breakdown torque.

**27. What is the function of rotary converter? Where it is used?**

Rotary converter converts low slip ac power. It is used in Kramer system, which is for the speed control of three-phase induction motor.

**28. What are the advantages of Kramer system of speed control?**

Any speed with in the working range can be obtained

When rotary converter is overexcited, it will take leading current, compensates with the lagging current drawn by the motor, thus improving power factor.

**29. Write the expression for concatenated speed of the set.**

Cumulative mode (Nsc) = $\frac{120f}{Pa + Pb}$

Differential mode (Nsc) = $\frac{120f}{Pa - Pb}$

Pa – no of poles of motor A

Pb – no of poles of motor B

## Long Questions:

1. With neat diagrams explains the working of any two types of starters used for squirrel cage type 3 phase induction motor.
2. Discuss the various starting methods of induction motors.
3. Explain the different speed control methods of phase wound induction motor
5. Explain the different speed control methods of phase wound induction motor
6. Discuss the theory of star – delta starter
7. Explain the cascade operation of induction motors to obtain variable speed
8. Explain the various techniques of sped control of induction motor from rotor side control.
9. Explain the various schemes of starting squirrel cage induction motor

## Unit –V

## SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES

**1. Name the two winding of single phase induction motor?**

Running and starting winding.

**2. What are methods available for making single phase induction motor a self starting?**

By slitting the single phase, by providing shading coil in the poles.

**3. What is the function of capacitor in single phase induction motor?**

To make phase difference between starting and running winding, to improve PF and to get more torque.

**4. State any 4 use of single phase induction motor?**

Fans, wet grinders, vacuum cleaner, small pumps, compressors, drills. Explain

**5. Why single phase induction motor is not a self starting one?**

When motor fed supply from single phase, its stator winding produces an alternating flux, which doesn't develops any torque.

**6. What kind of motors used in ceiling fan and wet grinders?**

Ceiling fan - Capacitor start and capacitor run single phase induction motor, wet

grinders - Capacitor start capacitor run single phase induction motor.

**7. What is the application of shaded pole induction motor?**

Because of its small starting torque, it is generally used for small toys, instruments, hair driers, ventilators.etc.

**8. In which direction a shaded pole motor runs?**

The rotor starts rotation in the direction from unshaded part to the shaded part.

**9. Why single phase induction motor have low PF?**

The current through the running winding lags behind the supply voltage by large angle so only single phase induction motor have low PF.

**10. Differentiate between "capacitor start" & "Capacitor start capacitor run" single phase induction motor?**

Capacitor start – capacitor is connected series with starting winding, but it will be disconnected from supply when motor pick up its speed. Capacitor start capacitor run# starting winding and capacitor will not be disconnected from supply even though motor pickup its speed.

**11. What are the principal advantages of rotating field type construction?**

Relatively small amount of power required for field system can easily supplied to rotating system using slip rings and brushes, more space is available in the stator part of the machine to provide more insulation, it is easy to provide cooling system, stationary system of conductors can easily be braced to prevent deformation.

**12. Why an induction motor never runs at its synchronous speed?**

If it runs at sy.speed then there would be no relative speed between the two, hence no rotor emf, so no rotor current, then no rotor torque to maintain rotation.

**13. What are the advantages of cage motor?**

Since the rotor has low resistance, the copper loss is low and efficiency is very high. On account of simple construction of rotor it is mechanically robust, initial cost is less; maintenance cost is less, simple starting arrangement.

**14. Why an induction motor is called as rotating transformer?**

The rotor receives same electrical power in exactly the same way as the secondary of a two winding transformer receiving its power from primary. That is why induction motor is called as rotating transformer.

**15. What is the use of shading coil in the shaded pole motor?**

In shaded pole motors the necessary phase –splitting is produced by induction. These motors have salient poles on stator and a squirrel cage type rotor. The poles are shaded ie each pole carries a copper band one of its unequally divided part is called shading band. When single phase ac supply is given to the stator winding due to shading provided to the poles a rotating magnetic field is generated.

**16. Why capacitor –start induction motors advantageous?**

In capacitor start induction motors capacitor is connected in series with the auxiliary winding. When speed of the motor approaches to 75 to80%of the synchronous speed the starting winding gets disconnected due to the operation of the centrifugal switch. The capacitor remains inthe circuit only at start. The starting torque is proportional to phase angle ά and hence such motors produce very high starting torque.

**17. List out 4 applications of shaded pole induction motor?**

Shaded pole motors have very low starting torque, low power factor and low efficiency. The motors are commonly used for small fans, toy motors, advertising displays, film projectors, record players, gramophones, hair dryers , photocopying machines etc

**18. What are the drawbacks of the presence of the backward rotating field in a single phase induction motor?**

Due to cutting of flux, emf gets induced in the rotor which circulates rotor current .the rotor current produces rotor flux. This flux interacts with forward component φf to produce a torque in one particular direction say anticlockwise direction. While rotor flux interacts with backward component $\varphi_b$ to produce a torque in the clockwise direction. So if anti clock wise torque is positive then clockwise torque is negative thus net torque experienced by the rotor is zero at start.

**19. Why is hysteresis motor free from mechanical and magnetic vibrations?**

The stator of hysteresis motor carries main and auxiliary windings to produce rotating magnetic field or of shaded pole type also. The rotor is smooth cylindrical type made up of hard magnetic material. The torque in this motor is constant at all speeds it runs at synchronous speed. There is not relative motion between stator and rotor field so the torque due to eddy current vanishes. Only hysteresis torque is present which keeps rotor running at synchronous speeds .the high retentivity ensures continuous magnetic locking between stator and rotor. Hence it is free from magnetic vibrations

**20. What types of motor is used in computer drives and wet grinders?**

For computer drives permanent magnet dc motors are used while in wet grinder's universal motor may be used.

**21. Give two advantages and two applications of stepper motor.**

Advantages:

*These motors are compatible with digital equipments and are flexible in operation.

*The dynamic response is fast

Applications:

Stepper motors are widely used in computer peripherals such as serial printers tape drives, floppy disk drivers. They are also used in control of machine tools. Robotics.

**22. List some applications of linear induction motor?**

They are used in machine tool industry and in robotics .They are used in trains operated on magnetic levitation , reciprocating compressors can also be driven by linear motors

**23. What are the specific characteristic features of the repulsion motor?**

Repulsion motors give excellent performance characteristics. A very high starting torque of about 300 to350% of full load can be obtained with starting currents of about 3 to 4 times the full load current. Thus it has got very good operating characteristics. The speed of the motor changeswith load .with compensated type of repulsion motor the motor runs with improved power factor as the quadrature drop in the field winding is neutralized. Also the leakage between armature and fieldis reduced which gives better regulation.

**24. Discuss characteristics of single phase series motor**

* To reduce the eddy current losses, yoke and pole core construction is laminated

*The power factor can be improved by reducing the number of turns. But this reduces the field flux.

But this reduction in flux increases the speed and reducing the torque. To keep the torque same it is necessary to increase the armature turns proportionately. This increases the armature inductance.

**25. What are the demerits of repulsion motor?**

*very expensive

*speed changes with load

* on no load speed is very high causing sparking at brushes

*low power factor on no load

**26. List four applications of reluctance motors?**

This motor is used in signaling devices, control apparatus, automatic regulators, recording instruments, clocks and all kinds of timing devices, teleprinters, gramophones

27.**What is a universal motor?**

There are small capacity series motors which can be operated on dc supply or single phase ac supply of same voltage with similar characteristics called universal motors. The construction of this motor is similar to that of ac series motor

## long Questions:

1. Give the classification of single phase motors .Explain any two types of single phase induction motors.
2. Explain the double field revolving theory for operation of single phase induction motor.
3. Explain the operation of shaded pole induction motor with diagram.
4. Develop equivalent circuit of a single phase induction motor ignoring core losses.
5. Explain the working principle of single phase induction motor .Mention its four applications.
6. What is the principle and working of hysteresis motor? Explain briefly.
7. Explain the construction and working of stepper motor.
8. Explain the principle of operation and applications of reluctance motor.
9. Explain the principle of operation and applications of repulsion motor and hysteresis motor.

QUESTION AND ANSWERS

TRANSFORMERS

**1. What is the function of a transformer?**

Transformers are energy converting devices, converting AC electrical energy with one level of voltage and current, to AC electrical energy with another level of voltage and current

**2. Mention the difference between core and shell type transformers.**

In core type, the windings surround the core considerably and in shell type the core surround the winding.

**3. What is the purpose of laminating the core in transformers?**

To reduce eddy current loss.

**4. Give the emf equation of a transformer and define each term.**

Emf induced in primary coil E1 = 4.44 $fF_mN_1$ volt Emf induced in secondary coil E2 = 4.44$fF_mN_2$ volt

Where,

f is the frequency of AC input

$F_m$ is the maximum value of flux in the core

$N_1$, $N_2$ are the number of primary and secondary turns.

**5. Does the transformer draw any current when secondary is open? Why?**

Yes, it (primary) will draw the current from the main supply in order to magnetize the core and to supply iron and copper losses on no load. There will not be any current in the secondary since secondary is open.

**6. Define voltage regulation of a transformer**

The change in secondary terminal voltage from no load to full load expressed as a percentage of no load or full load voltage is termed as regulation.

% regulation = (0V2-V2) x 100/0V2

**7. Full load copper loss in a transformer is 1600 watts. What will be the loss at half load?**

If x is the ratio of actual load to full load then copper loss = x2(full load copper loss).Here Wc = (0.5)2 x 1600 = 400 watts

**8. Define all day efficiency of a transformer.**

It is the computed on the basis of energy consumed during a certain period, usually a day of 24 hs.

All day efficiency = output in kWh for 24 hrs /input in kWh for 24 hrs.

**9. Why transformers are rated in kVA ?**

Copper loss of a transformer depends on current and iron loss on voltage. Hence total losses depend on Volt- Ampere and not on the power factor. That is why the rating of transformers is in KVA and not in KW.

**10. Why are breathers used in transformers?**

Breathers are used to entrap the atmospheric moisture and thereby not allowing it to pass on to the transformer oil. Also to permit the oil inside the tank to expand and contract as its temperature increases and decreases. Also to avoid sledging of oil i.e. decomposition of oil. Addition of 8 parts of water in 1000000 reduces the insulations quantity of oil. Normally silica gel is filled in the breather having pink color. This color will be changed to white due to continuous use, which is an indication of bad silica gel, it is normally heated and reused.

**11. A 1100/400 V, 50 Hz single phase transformer has 100 turns on the secondary winding. Calculate the number of turns on its primary.**

We know $V1 / V2 = k = N2 / N1$

Substituting $400/1100 = 100/N1$

$N1 = 100/400 \times 1100$

$= 275$ turns.

**12. What are the functions of no-load current in a transformer?**

No-load current produces flux and supplies iron loss and copper loss on no-load.

**13. Can the voltage regulation of a transformer go to negative? If so under what condition?**

Yes. If the load has leading power factor.

**14. What is meant by turns ratio in transformer?**

Turns ratio in transformers,K is the ratio of number of turns in the secondary winding $T_2$ to number of turns in the primary winding $T_1$

$K = T_2/T_1$

**15. Why are cooling tubes provided in transformer tanks?**

By providing cooling tubes, oil circulation and hence heat dissipation can further be improved by providing cooling tubes in two or all four walls of the transformer tanks

**16. When will a Bucholz relay operate in a transformer?**

Bucholz rely is a protective device in a transformer. If the temperature of the coil exceeds its limit, Bucholz relay operates and gives an alarm.

**17. List out general application of transformers.**

1) Stepping-up of voltage
2) Stepping-down of voltage
3) Instrument extension
4) Electrical isolation
5) Impedance matching
7) Link between AC and DC systems

**18. What is the purpose of conducting open circuit and short circuit tests in transformers?**

Open circuit Test:
i) To find out the equivalent circuit parameters $R_0$ & $X_0$ or no load resistance and reactance.
ii) To find out the Iron loss of the transformer.

Short circuit Test:
i) To find out the equivalent circuit parameters $R_{01}$ & $X_{01}$ or esistance and reactance of the transformer referred to primary or secondary
iii) To find out the copper loss of the transformer
By using these two tests we can find out the efficiency and regulation of the transformer.

**19. What do you understand by ideal transformer?**

If the properties of transformer be idealized in that the winding resistances are negligible and assume that all the flux is conferred to the core and links both windings core losses are negligible, and permeability of core is so higher that only a negligible exciting MMF in required to establish the flux. these properties are closely approached but never actually attained in practical transformers. A hypothetical transformer having these properties is called an "ideal transformer"

**20. If a transformer is operated at a frequency other than the designed one, what will happen to its performance?**

Iron loss increases with a decrease in frequency. For example if a 60 HZ transformer is allowed to work at 50Hz supply. the iron loss will increase by 11% so heating will be more and the efficiency will decrease when worked on lower frequency.

**21. Can you apply D.C supply in a single phase transformer? Give reason for your answer.**

Transformer should not be connected to a D.C Source. If the primary of a transformer is connected to D.C supply mains, the flux produced will not vary but remain constant in magnitude and therefore no EMF will be induced in the secondary winding. Also there will be no back EMF induced in the primary winding and therefore a heavy current will be drawn from the supply which may result in the burning out of the winding.

**22. State the principle of operation of a transformer.**

Transformer operates on the principle of mutual induction between inductively coupled coils. When A.C source is connected to one coil flux is produced in the core which links both the coils. As per the Faraday's laws of electromagnetic induction EMF is induced in the secondary coil also. if the external circuit is closed power is supplied.

**23. A single phase transformer designed for 50 Hz operation is connected to a supply of 60 HZ. What will happen?**

The iron loss will be reduced, less heating and the efficiency will increase.

**24. Why is the rating of transformer given in KVA?**

Copper loss of a transformer depends on current and iron loss on voltage. Hence, total transformer loss depends on volt ampere (VA) and not on phase angle between voltage and current i.e, it is independent of load power factor. That is why rating of transformer is in KVA and not in KW.

**25. How do you reduce hysteresis loss in a transformer?**

Hysteresis loss can be reduced by selecting suitable core material silicon steel is having less stein metz hysteresis co-efficient.

**26. In O.C test in single phase transformer why do you use low power factor watt meter to measure the power?**

The power factor of the circuit at no-load is very low. So if a low power factor watt meter is used, the reading will be very accurate.

**27. The efficiency of a transformer is always higher than that of rotating electric machines, why?**

In rotating electric machines there is mechanical losses (frictional and wind age losses) due to the rotating parts. As there is no rotating part in transformer, efficiency of transformer is always higher than rotating electric machines.

**28. Explain why only low voltage is applied to the transformer during short circuit test?**

In this test the terminals of the secondary winding are short- circuited, therefore transformer becomes equivalent to a coil having an impedance equal to impedance of both the windings. The value of impedance is also very low. Therefore low voltage is sufficient for the circulation of full load, current to find the copper loss, resistance and reactance.

**29. State why the open circuit test on a transformer is conducted at rated voltage?**

The purpose of this test is to determine coreloss and no-load current I0 which is helpful in winding X0 and R0 Only with normal voltage applied to the primary, normal flux will be set up in the core, hence normal iron losses will occur.

**30. What are the conditions for parallel operation of 3-phase transformers?**

i. Should have equal voltage ratio.
ii. The phase sequence must be the same.
iii. The percentage impedance of the transformers should be equal
iv. The transformers to be connected in parallel should belong to the same vector group.

**31. State some advantages of shell type transformer**

Advantages of shell -type transformer:

i. Better cooling
ii. Less leakage reactance
iii. Greater mechanical strength
iv. Less magnetising current.

**32.** The no-load ratio required in a single phase 50 Hz transformer is 6600/300V. If the maximum value of flux in the core is to be about 0.09 weber. Find the number of turns in each winding.

**33.** The no load current of a transformer is 15A at a power factor of 0.2 when connected to a 460V, 50 Hz supply. If the primary winding has 550 turns Calculate.

i) The magnetizing component (I□).
ii) Iron loss (Wo)

**34.** Find (i) active component and reactive components of no-load current and (ii) no-load current of a 230V/ 115V single-phase transformer if the power input on no-load to the high voltage winding is 70 Kl and power factor of no-load current is 0.25 lagging.

## PART – B

1. What are the tests required to draw the equivalent circuit of a Single phase Transformer? How they are conducted? (Nov – 02)

2. Draw phasor diagram to represent conditions in a single-phase transformer-supplying load at1. Unity p.f , 2.Lagging p.f 3. Leading p.f (Nov-02)

3. Explain the Back to back method of testing of two identical single phase transformers (May03)

4. Explain the construction and principle of operation of single phase transformer (A 97)

5. Deduce the equivalent circuit of a Transformer (Oct – 97)

6. Derive the emf equation of the Transformer (April – 99)

7. List the losses, which occur in a loaded transformer. Deduce the relationship between losses for maximum efficiency (Oct –97)

8. Derive the condition for maximum efficiency of a Transformer (Oct–98)

9. Explain the types of testing of transformer

10. Explain the Construction of 3 phase Transformer (Apr- 99)

11. Describe the various three phase transformer connections. (Apr - 99)

12. State and explain the necessary conditions for parallel operation of three phase transformers.

13. Explain about auto transformer and drive an expression between the weight of winding material of auto and ordinary transformer.

14. What is Scott connection and explain how phase conversion is carried out?

15. A 6600/440V Single phase 600 KVA transformer has 1200 primary turns. Find (i) Transformation ratio (ii) Secondary turns (iii) Voltage / turn (iv) Secondary current when it supplies a load of 400 kW at 0.8 p.f. lagging.

16. A 50 KVA, 4400/220 V, transformer has R1 = 3.45 Ω; R2 = 0.009Ω. The values of reactances are X1 = 5.2Ω and X2 = 0.015Ω. Calculate for the transformer.

(i) Equivalent resistance referred to primary

(ii) Equivalent reactance reference to primary

(iii) Equivalent impedance reference to primary

(iv) Equivalent resistance, reactance and impedance referred to secondary.