**Module-1: Fundamentals of AC Windings**

1. Number of parallel path in lap winding is equal to
2. 2
3. Number of poles
4. Number of pair of poles
5. None of the above
6. Pole pitch is equal to
7. 0˚
8. 60˚
9. 90˚
10. 180˚
11. Relation between electrical angle *θe* and mechanical angle *θm*

Where, P is the number of Poles

1. Concentrated winding differ from distributed winding with the concern of
2. Identical magnetic axis
3. Two magnetic axis
4. No magnetic axis
5. Physical spacing
6. DC machines have \_\_\_\_\_windings and synchronous machines use \_\_\_\_\_windings.
7. Closed, open
8. Open, closed
9. Open, closed
10. Closed, closed
11. If coil side in one slot is connected to a coil side in another slot which is one pole pitch away from first slot, the winding is sail to be
12. Short pitched
13. Full pitched
14. Concentrated
15. distributed
16. Due to short pitching, the induced EMF gets
17. Reduced
18. Increased
19. Remains same
20. None of the aove
21. In a full pitch winding coil span for 4 pole, 12 slot armature winding is\_\_\_\_ slots
22. 24
23. 12
24. 6
25. 3
26. The armature of a three phase 8 pole alternator has 120 slots. The distribution factor is equal to
27. 1
28. 0.957
29. 0.946
30. 0.897
31. For a short pitch and distributed winding, the value of coil span factor and distribution factor
32. Both are less than unity
33. Less than unity and greater than unity
34. Greater than unity and less than unity
35. Both ate greater than unity
36. Slots angle for 4 pole, 48 slot armature winding is\_\_\_\_ electrical degree
37. 180
38. 90
39. 30
40. 15
41. Compare Lap and Wave winding. Where each type is used and why?
42. Why double layer winding is preferred?
43. What are the advantages of fractional slot winding over integral slot winding?
44. Explain how fractional winding reduce the emf’s of ripple frequencies.
45. Calculate the fundamental, third and fifth harmonics breadth factors for a stator with 36 slots wound for 3 phase, 4 poles.
46. A 3 phase, 16 pole synchronous generator has a star- connected winding with 144 slots and 10 conductors per slot. The flux per pole is 0.04 Wb ( sinusoidal distributed) and the speed is 375 rpm. Find the frequency and phase and line induced emf’s.the total turns/phase may be assumed to be series connected.
47. Derive the expression for distribution factor *Kd* of a phase of the winding consists of coils arranged in *m* consecutive slots.
48. Define the followings
49. Slot angle
50. Pole pitch
51. Coil pitch
52. Pitch factor
53. Distribution factor

**Module-2**

1. Three phase voltages are applied to the three windings of electrical machine. If any two supply terminals are interchanged then the rotating MMF wave \_\_\_\_\_\_
2. Direction reverse, amplitude alters
3. Direction reverse, amplitude unaltered
4. Direction remains same, amplitude alters
5. Direction reverse same, amplitude unaltered
6. For P pole machine, which of the following statements are correct regarding the rotating field speed?
7. 120P/f Revolution per cycle
8. 120P/f Revolution per second
9. 120f/P Revolution per cycle
10. 120f/P Revolution per second
11. The speed at which rotating magnetic field revolves is called
12. Induction speed
13. Synchronous speed
14. Relative speed
15. Rotating speed
16. What is the amplitude of rotating MMF produced as a result of m-phase currents flowing in m-phase windings?
17. 2Fm/m
18. mFm
19. mFm/2
20. Fm
21. The peak of rotating MMF wave (FR) is directed along which of the following axis?
22. The axis of that phase which carries the maximum current at that instant
23. The axis of that phase which carries half of the maximum current at that instant
24. The axis of that phase which carries the minimum current at that instant
25. None of the above
26. Which of the following statements are correct regarding individual phase MMF in rotating machines
27. It is a rotating MMF wave
28. It is not a rotating MMF wave and its amplitude doesn’t alternate along its own phase
29. It is not rotating MMF wave but its amplitude merely pulsates
30. None of the above
31. The amplitude of rotating MMF wave is proportional to
32. Nph and P
33. I and P
34. Nph and I
35. Nph , I and P
36. The effect of poly phase currents in poly phase winding can be compared to \_\_\_\_
37. Mechanical rotation of permanent magnets at synchronous speed
38. Mechanical rotation of DC excited field poles at synchronous speed
39. Mechanical rotation of either permanent magnets or DC excited field poles at synchronous speed
40. None of the above
41. For balanced 3 phase current in three phase distributed winding, the magnitude of rotating flux \_\_\_\_at all instant of time.
42. Changes
43. Remains constant
44. Pulsates
45. None of the above
46. If φm is the maximum value of flux due to any one phase, then resultant flux in 2 phase and 3 phase AC machines would respectively be given by\_\_\_\_\_
47. φm stand still and 1.5 φm rotating
48. φm and 1.5 φm both rotating
49. 1.5 φm and 2 φm both rotating
50. 2φm and 3 φm both rotating
51. Describe Rotating Magnetic Field of 3 phase distributed winding

**Module-3 Induction Machines**

1. An eight pole, 50 hertz slip ring induction motor running at 720r.p.m. with the slip rings short circuited has a slip percent of
2. 60%;
3. 15%;
4. 6%;
5. 4%.
6. The rotor windings of a slip ring induction motor are connected to an external
7. source of a.c. supply;
8. source of d.c. supply;
9. variable resistance;
10. star delta starter.
11. A squirrel cage induction motor with a high resistance rotor, compared to one with a lower resistance, would have
12. a lower full load slip and greater starting torque;
13. a higher full load slip and greater starting torque;
14. a lower full load slip and smaller starting torque;
15. a higher full load slip and smaller starting torque.
16. The 'crawling" in an induction motor is caused by
17. High loads
18. Low voltage supply
19. Improper design of machine
20. Harmonics developed in the motor
21. A 3-phase 440 V, 50 Hz induction motor has 4% slip. The frequency of rotor e.m.f. will be
22. 200 Hz
23. 50 Hz
24. 2 Hz
25. 0.2 Hz
26. What will happen if the relative speed between the rotating flux of stator and rotor of the induction motor is zero?
27. The slip of the motor will be 5%
28. The rotor will not run
29. The rotor will run at very high speed
30. The torque produced will be very large
31. It is advisable to avoid line-starting of induction motor and use starter because
32. Motor takes five to seven times its full load current
33. It will pickup very high speed and may go out of step
34. It will run in reverse direction
35. Starting torque is very high
36. The principle of operation of a 3-phase induction motor is similar to that of a
37. Synchronous motor
38. Repulsion - start induction motor
39. Transformer with a shorted secondary
40. Capacitor - start, induction - run motor
41. The 'cogging' of an induction motor can be avoided by
42. Proper ventilation
43. Using DOL starter
44. Autotransformer starter
45. Having number of rotor slots more or less than the number of stator slots (not equal)
46. Resistance is added to the rotor circuit of a slip induction motor to
47. increase torque at lower speeds;
48. reduce current during starting;
49. reduce the speed of the motor;
50. all of the above.
51. A 3-phase. 4-pole slip ring induction motor is connected to 3-phase. 50 Hz supply from the rotor side through slip rings and the stator tem1inals are shorted. The machine is found to be running at 1440 rpm. Determine :
52. The frequency of stator current.
53. The speed of rotor magnetic tield w.r.t. rotor and its direction w.r.t. direction of rotation of rotor.
54. The speed of stator magnetic field w.r. t. stator and its direction w.r.t. direction of rotation of rotor.
55. The speed of stator magnetic' field w.r. t. rotor magnetic field.
56. Why does the induction motor not rotate at synchronous speed?
57. Explain the Speed control methods of 3 Phase Induction Motor
58. Draw the torque speed characteristics of a 3 phase induction motor and clearly indicate the effect of change in rotor resistance.
59. Explain the different methods of starting an induction motor.
60. Give comparison between squirrel cage and slip ring induction machine? Discuss the working principle of three phase induction motor.
61. No load and short circuit tests conducted on 3φ, 5 HP, 220 volts, 60 Hz, 1800 rpm induction motor gave the following results. No load test: 220 volts, 4.35 amps, 244 watts Short circuit test: Voltage of 220 volts produces a current of 64.5 Amps; Resistance per phase = 0.545 ohms, Friction, windage and core loss = 213 watts. Obtain the equivalent circuit parameters.
62. The power input to a 500 V, 50 Hz, 6 pole 3 phase squirrel cage induction motor running at 975 rpm is 40 KW. The stator losses are 1 KW and the friction and windage losses are 2 KW. Calculate
63. Slip
64. Rotor copper loss
65. Mechanical power developed
66. The efficiency.
67. Draw the per phase approximate equivalent circuit of a 3 – phase induction motor at slip ‘s’ and derive the expression for electromagnetic torque developed by the motor. Derive also the condition for maximum torque and the expression for the maximum torque.
68. The shaft output of a three-phase 60- Hz induction motor is 80 KW. The friction and windage losses are 920 W, the stator core loss is 4300 W and the stator copper loss is 2690 W. The rotor current and rotor resistance referred to stator are respectively 110 A and 0.15 Ω . If the slip is 3.8%, what is the percent efficiency?
69. A 6 pole 3 phase induction motor develops 30 H P including mechanical losses totalling 2 H P, at a speed of 950 RPM on 550 volt, 50 Hz mains. If the power factor is 0.88 and core losses are negligible, calculate:
70. The slip
71. The rotor copper loss
72. The total input power if the stator losses are 2 Kw
73. The line current.
74. A 400V, 4-pole, 50 Hz, 3-phase, 10 hp, star connected induction motor has a no load slip of 1% and full load slip of 4%. Find the following:
75. Syn. speed
76. no-load speed
77. full-load speed.
78. frequency of rotor current at full-load
79. full-load torque.
80. A 400Volts, 1450 rpm, 50 Hz, wound-rotor induction motor has the following circuit model parameters. R1= 0.3 ohm R2=0.25 ohm X1=X2=0.6 ohm Xm= 35 ohm Rotational loss =1500 W. Calculate the starting torque and current when the motor is started direct on full voltage.
81. A 2300-V, three phase, 60 Hz, star-connected cylindrical synchronous motor has a synchronous reactance of 11 Ω per phase. When it delivers 200 hp, the efficiency is found to be 90% exclusive of field loss, and the power-angle is 15 electrical degrees as measured by a stroboscope. Neglect ohmic resistance and determine: (i) the induced excitation per phase. (ii) the line current Ia (iii) the power factor
82. A 3-phase induction motor has a starting torque of 100% and a maximum torque of 200% of full load torque. Find (i) Slip at maximum torque. (ii) Full load slip. (iii) Neglect the stator impedance
83. A 150kW, 3000V, 50Hz, 6-pole star-connected induction motor has a star-connected slip-ring rotor with a transformation ratio of 3.6 (stator/rotor). The rotor resistance is 0.1Ω/phase and its per phase leakage inductance is 3.61 mH. The stator impedance may be neglected. Find (i) the starting current and torque on rated voltage with shortcircuited slip-rings, and (ii) the necessary external resistance to reduce the rated voltage starting current to 30A and the corresponding starting torque.

**Module-4: Single Phase Induction Motors**

* 1. A ceiling fan uses

1. Split-phase motor.
2. Capacitor start and capacitor run motor.
3. Universal motor.
4. Capacitor start motor.
   1. In a capacitor start single-phase induction motor, the capacitor is connected
5. in series with main winding.
6. in series with auxiliary winding.
7. in series with both the windings.
8. in parallel with auxiliary winding.
   1. The torque developed by a single-phase induction motor at starting is
9. Less than the rated torque
10. More than the rated torque
11. Zero
12. None of the above
    1. Reduction in the capacitance of a capacitor-start motor, results in reduced
13. Noise.
14. Speed.
15. Starting torque.
16. Armature reaction.
    1. Rotor Slip with respect to forward rotating Field *Ff* and backward rotating field *Fb* respectively are
    2. In a capacitor start and run motors the function of the running capacitor in series with the auxiliary winding is to
17. Improve power factor
18. Reduce fluctuations in torque
19. Increase over load capacity
20. To improve torque
    1. Centrifugal switch is used to disconnect starting winding when motor has
21. Picked up 5-10% speed
22. Picked up 10% speed
23. Picked up 20% speed
24. Picked up 50-70% speed
    1. The direction of rotation of a split phase motor can be reversed by reversing the connection of
25. Starting winding
26. Running winding
27. Either a) or b)
28. None of the above
    1. In shaded pole motor the direction of motor is
29. From shaded pole to the main pole
30. From the main pole to shaded pole
31. Either a) and b)
32. None of the above
    1. If the starting winding of a single phase induction motor is left in the circuit, it will
33. Damage the starting winding
34. Run faster
35. Run Slower
36. Spark at light load
    1. Discuss why single phase induction motor do not have starting torque.
    2. Identify the motor being used in the ceiling fan and explain the method of its control.
    3. Describe with the aid of diagram of connection, phasor diagram and torque-slip characteristics, the working of capacitor-start single phase induction motor.
    4. Explain Double Revolving field theory of single Phase Induction motor.
    5. What are the advantages of a capacitor start motor over a resistant split phase motor.
    6. List the comparison between single phase and three phase induction motor.
    7. Explain Shaded-pole motor with necessary phasor and torque-slip characteristics.
    8. A 200-V,6-pole, 50-Hz, single-winding single-phase induction motor has the following equivalent circuit parameter as referred to the stator.

R1m = 3.0 Ω X1m= 5.0 Ω

R2 =1.5 Ω X2 = 2.0 Ω

Neglect the magnetizing current. When the motor runs at 97% of the synchronous Speed, compute the following:

1. The ratio of E*f / Emb*
2. The ratio of *Vf / Vb*
3. The ratio of *Tf /Tb*
4. The gross total torque
   1. A test on the main winding of a 1kW, 4 pole 215V, 50 Hz, single phase Induction motor gave following results:

|  |  |
| --- | --- |
| No-Load test | Block rotor test |
| *Vo = 215 V* | *VSC = 85 A* |
| *Io = 3.9 A* | *ISC = 9.80 A* |
| *Po =185 W* | *PSC = 390 W* |
| *R1 =1.6 Ω* |  |

Calculate the parameter of the circuit model assuming that the magnetizing reactance hangs at the input terminals of the model.

* 1. A 230 V, 50 Hz, 4-pole single – phase induction motor has the following equivalent circuit impedances:

*R1m*= 2.2 Ω, *R2*’ = 4.5 Ω

*X1m* = 3.1 Ω *X2’* = 2.6 Ω

Friction and windage and core loss =40W

For a slip of 0.03 pu, calculate (i) input current, (ii) power factor, (iii) developed power, (iv) output power, (e) efficiency.

**Module-5 Synchronous Machines**

1. In a salient pole synchronous motor, the developed reluctance torque attains the maximum value when the load angle in electrical degrees is
2. 0
3. 45
4. 60
5. 90
6. If a synchronous motor is running at a leading power factor, its excitation induced voltage (Er) is
7. equal to terminal voltage
8. higher than terminal voltage
9. lesser than terminal voltage
10. depandent on supply voltage
11. In a synchronous machine, hunting is predominantly damped by
12. mechanical loss in the rotor
13. iron loss in the rotor
14. copper loss in the stator
15. copper loss in the rotor
16. A three-phase, salient pole synchronous motor is connected to an infinite bus. It is operated at no load a normal excitation. The field excitation of the motor is first reduced to zero and then increased in reverse direction gradually. Then the armature current
17. Increases continuously
18. First increases and then decreases steeply
19. First decreases and then increases steeply
20. Remains constant
21. In a stepper motor, the detent torque means
22. minimum of static torque with phase winding excited
23. maximum of the static torque with phase winding excited
24. minimum of the static torque with phase winding unexcited
25. maximum of the static torque with phase winding unexcited
26. Synchronizing power of a synchronous machine is
27. directly proportional to the synchronous reactance
28. Inversely proportional to the synchronous reactance
29. Equal to the synchronous reactance
30. None of the above
31. When the voltage applied to a synchronous motor is increased, which of the following will reduce?
32. Stator flux
33. Pull in torque
34. Both (a) and (b)
35. None of the above
36. Which of the following methods is used to start a synchronous motor?
37. Damper winding
38. Star-delta starter
39. Damper winding in conjunction with star-delta starter
40. Resistance starter in the armature circuit
41. Stability of a synchronous machine
42. Decreases with increase in its excitation
43. Increases with increase in its excitation
44. Remains unaffected with increase in excitation
45. Any of the above
46. The effect of increasing the load on a synchronous motor running with normal excitation is to
47. Decrease both armature current and power factor
48. Decrease armature current but increase power factor
49. Increase armature current but decrease power factor
50. Increase both its armature current and power factor
51. In a synchronous motor, V-curves represent relation between
52. Armature current and field current
53. Power factor and speed
54. Field current and speed
55. Field current and power factor
56. Describe how the synchronous reactance of a synchronous machine is determined.
57. Explain two important functions served by the damper winding in a synchronous motor. State the various applications of synchronous motor.
58. Explain the constructional features of synchronous generator. What are the two types of generators? Derive emf equation of a synchronous machine.
59. What are the two types of constructions that are employed in synchronous machines? Explain the two machines and give with reasons which of them are simple to model and analyze.
60. A 4-pole alternator has an armature with 25 slots and 8 conductors per slot and rotates at 1500 rpm and the flux per pole is 0.5 Wb. Find the emf generated, if winding factor is 0.96 and all the conductors are series.
61. Define armature reaction and explain the effect of armature reaction on the different power system loads of synchronous generator.
62. A 3-phase, Y-connected synchronous generator rated at 10 KVA and 230 V has a synchronous reactance of 1.2 ohm per phase and an armature resistance of 0.5 ohm per phase. Calculate the % voltage regulation at full load with 0.8 lagging power factor.
63. Two 3-ϕ, 6.6 kV, star-connected alternators supply a load of 3000 kw at 0.8 power factor lagging. The synchronous impedance per impedance per phase of machine *A* is 0.5+ j10Ω and of machine B is 0.4 + j12 Ω The excitation of machine A is adjusted so that it delivers 150 A at a lagging p.f. and the governors are so set that the load is shared equally between the machine. Determine the current, power factor, induced e.m.f. and load angle of each machine.
64. A 3 – φ, 11 KV star connected synch. motor takes 50 A input current. The effective resistance and synchronous reactance per phase are 1 Ω and 30 Ω respectively. Calculate the induced emf for a power factor of (a) 0.8 lagging (b) 0.8 leading and (c) the power supplied to the motor.
65. A 3-phase 2.5MVA, 6.6V synchronous generator gave the following data for occ at synchronous speed

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| If (A): | 16 | 20 | 25 | 32 | 45 |
| Voc(line)(V) | 4400 | 5500 | 6600 | 7700 | 8800 |

with the armature short-circuited and full load current flowing, the field current is 18 A. when the in/c is applying full-load current at zero Bt at rated voltagee, the field current is 45 A. Determine the leakage reactance in Ω per phase and the full-load armature reaction in terms of equivalent field amperes. Find also the field current and voltage regulation when the m/c is supplying full load at 0.8p.f lagging at rated voltage neglect armature resistance.

1. (a)Explain the emf method of determining the reguglation of an alternator.

(b)State and explain the conditions for parallel opertaion of alternator.

1. A 75-MVA; 13.8 kV, three-phase, eight-pole,60 Hz salient pole synchronous machine has the following d-axis and q-axis reactances :Xd=1.0 p.u. and Xq = 0.6 p.u. The synchronous generator is delivering rated MVA at rated voltage and 0.866 power factor lagging. Choose a power base of 75 MVA and voltage base of 13.8 kV.
2. Draw the phasor diagram of the machine.
3. Compute the excitation voltage Ef
4. If the machine is connected to 3-phase system. having 1.0 p.u. voltage, find the maximum power that generator can deliver.