5 Single-Phase Motor & Special Machine and Energy Conversion Principles

Multiple Choice Questions

1. Consider the following steps
   1. Reversion connections to the terminals of the capacitor.
   2. Changing the position of the capacitor from auxiliary winding circuit to main winding circuit.
   3. Reversing supply connection to the main winding.
   4. Reversing supply connection to the auxiliary circuit.

   While installing a new ceiling fan, if the fan motor is found to be rotating in the wrong direction, then the direction of rotation of the motor can be corrected by
   (a) 1, 2 and 3 (b) 1, 2 and 4
   (c) 1, 3 and 4 (d) 2, 3 and 4
   [IAS-1994]

2. **Assertion (A):** Solid state regulators are finding favour in speed control of domestic fans, over conventional resistance and inductance type regulators.
   Reason (R): Solid state regulators are compact, relatively less expensive, energy efficient, more reliable and afford noise-free operation.
   (a) Both A and R are true and R is the correct explanation of A.
   (b) Both A and R are true but R is NOT the correct explanation of A.
   (c) A is true but R is false.
   (d) A is false but R is true.
   [IAS-1994]

3. In a line printer used to print the output of a computer, the paper is required to be advanced by a line spacing as soon as printing of the line is over. Which one of the following motors is best suited for this application?
   (a) DC motor (b) Synchronous motor
   (c) Induction motor (d) Stepper motor
   [IAS-1995]

4. Consider the following statements about single-phase reluctance motor:
   1. The starting torque is function of rotor position.
   2. The torque developed at subsynchronous speeds varies sinusoidally.
   3. Starting is asynchronous but running is synchronous.
   4. It pulls into synchronism on switching on dc excitation.

   Of these statements
   (a) 1, 2 and 3 are correct
   (b) 1, 3 and 4 are correct
   (c) 2, 3 and 4 are correct
   (d) 1 and 4 are correct **[IAS-1996]**

5. The capacitor-start single-phase induction motor develop much larger starting torque in comparison with the "split-phase" motor, because the use of capacitors in the auxiliary winding enables
   (a) provision of larger number of turns in the auxiliary winding.
   (b) a larger starting current to be drawn from the supply.
   (c) the torque-slip characteristic in general to get a shape to give a large starting torque.

(d) starting and a speed slightly below synchronous speed

[IAS-1998]

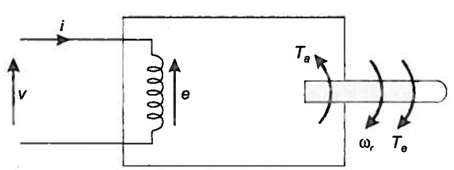
6. Two ensure that a two-phase induction type servomotor does not run when the control phase voltage is zero, the ratio of
(a) stator leakage reactance to rotor phase resistance should be high.
(b) rotor leakage reactance to rotor phase resistance should be less than one.
(c) the sum of stator and rotor resistance to the sum of stator and rotor leakage reactance should be greater than one.
(d) torque to inertia should be very high.

[IAS-1999]

7. **Assertion (A):** The generated voltage in 3-phase supply contains harmonics.
Reason (R): The angular variation of the radial component of the magnetic flux in the air-gap is not a pure sinusoid.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is NOT the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

[IAS-1999]

8. The below figure shows an electro-mechanical energy conversion device. The instantaneous values of armature induced emf, bus bar voltage and armature current are respectively e, v and i. The instantaneous values of external torque, armature developed torque and angular velocity of the shaft are respectively T_e, T_a and ω_r. If the armature is connected to supply bus, the mode of operation will be



(a) motoring
(b) both motoring and generating
(c) generating
(d) braking

[IAS-1999]

9. For a given load, the speed of shaded-pole single-phase induction motor fluctuates slightly because
(a) the speed of the magnetic field is not constant
(b) the magnitude of the magnetic field is not constant
(c) the motor operates at higher value of slips
(d) the motor is used with fluctuating load

[IAS-1999]

10. When a single-phase capacitor start induction motor is running at a steady speed delivering a fixed torque, then
(a) peak of forward rotor mmf is equal to the peak of backward rotor mmf
(b) peak of forward startor mmf is equal to the peak of backward stator mmf
(c) net forward rotating flux is equal to the net backward rotating flux
(d) forward flux produced by rotor current is equal to backward flux produced by rotor current

[IAS-2001]

11. In the slew range of a stepper motor, it
(a) can start, stop and reverse as desired
(b) cannot start but can stop and reverse on command
(c) cannot start, stop and reverse on command
(d) cannot start and synchronise but can reverse on command

[IAS-2001]

12. Consider the following statements:
A ceiling fan fails to start because
1. main winding is open-circuited.
2. auxiliary winding is open-circuited.
3. capacitor is short-circuited.
4. supply terminals are reversed.
5. main and auxiliary winding connections are interchanged.

Which of the statements are correct?
(a) 1, 2 and 5 (b) 2, 3, 4 and 5
(c) 1, 2 and 3 (d) 1, 3 and 4

[IAS-2001]

13. Consider the following statements for a single-phase hysteresis motor:
1. Torque is constant from standstill up to synchronous speed N_s.
2. Rotor is provided with narror slots embedded with bars.
3. Torque at starting is some what more than that at synchronous speed N_s.
4. As the name suggests, only hysteresis torque is produced from zero speed right up to N_s.
5. Rotor material possesses very wide hysteresis loop.

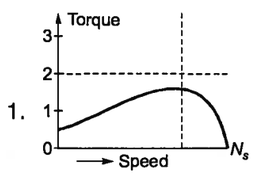
Which of the statements given above are correct?
(a) 1, 2 and 3 (b) 3 and 5
(c) 1 and 4 (d) 2, 3 and 4

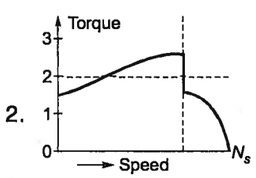
[IAS-2001]

14. Match **List-I** with **List-II** and select the correct answer using the codes given below the lists:

List-I
A. Capacitor-run motor
B. Capacitor-start and run motor
C. Shaded-pole motor
D. Resistor-split phase motor

List-II

1.


2.


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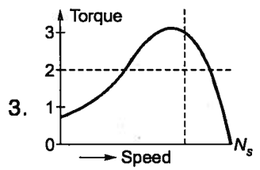

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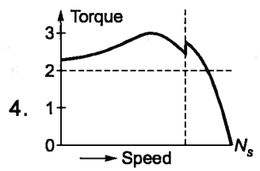


Codes:

	A	B	C	D
(a)	2	1	4	3
(b)	2	3	1	4
(c)	3	4	2	1
(d)	3	4	1	2

[IAS-2005]

15. A 230 V, 50 Hz, 4-pole, single-phase induction motor is rotating in the clockwise (forward) direction at a speed of 1425 rpm. If the rotor resistance at standstill is 7.8 Ω, then the effective rotor resistance in the backward branch of the equivalent circuit will be
(a) 2 Ω (b) 4 Ω
(c) 78 Ω (d) 156 Ω

[GATE-2008]

16. For a single phase capacitor start induction motor, which of the following statements is valid?
(a) The capacitor is used for power factor improvement
(b) The direction of rotation can be changed by reversing the main winding terminals
(c) The direction of rotation cannot be changed
(d) The direction of rotation can be changed by interchanging the supply terminals

[GATE-2006]

17. **Assertion (A):** A single-phase induction motor is not self-starting as such.
Reason (R): A single-phase induction motor develops only pulsating magnetic field which provides zero torque at standstill.

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is NOT the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

[ESE-2004]

18. Which one of the following types of motors is most suitable for a computer printer drive?
(a) Reluctance motor
(b) Hysteresis motor
(c) Shaded pole motor
(d) Stepper motor [ESE-2004]

19. For a reluctance type motor, if the stator magnetic field angular velocity is ω and the actual rotor angular velocity is ω_r, then which one of the following equations is satisfied if the average electromagnetic torque is not zero?
(a) $\omega = \omega_r/2$ (b) $\omega = \omega_r$
(c) $\omega = 2\,\omega_r$ (d) $\omega = 4\,\omega_r$

[ESE-2004]

20. Which one of the following statements is correct?
When a single phase induction motor is excited with single phase a.c. voltage, the magnetic field set up is equivalent to
(a) two fields, rotating in opposite directions with different speeds
(b) two fields, rotating at synchronous speed in opposite directions
(c) two fields, rotating at synchronous speed
(d) two fields rotating in the same direction but at different speeds

[ESE-2004]

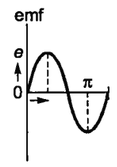
21. A capacitor-start single-phase induction motor is used for
(a) Easy to start loads
(b) Medium start loads
(c) Hard to start loads
(d) Any type of start loads [ESE-2005]

22. In hand-tool applications, which one of the following single-phase motors is used?
(a) Shaded pole motor
(b) Capacitor start motor
(c) Capacitor run motor
(d) Universal motor

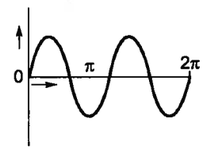
[ESE-2005]

23. An elementary cylindrical machine has one full-pitch coil in the stator, but the rotor may have (i) two poles or (ii) four poles of permanent magnets.
The time-varying voltage that could be induced in the stator coil for one rotation of the rotor, while the rotor is revolving at a constant speed are shown in the figures *A*, *B*, *C* and *D* below.

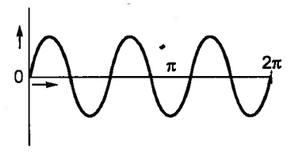
A.



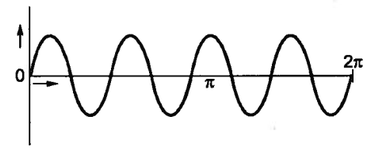
B.



C.



D.



	2-pole	4-pole
(a)	A	D
(b)	A	B
(c)	C	D
(d)	B	C

[ESE-2006]

24. Match **List-I** with **List-II** and select the correct answer using the codes given below the lists:
List-I
A. General purpose split phase FHP motor
B. General purpose capacitors start FHP motor
C. Permanent split capacitors start FHP motor
D. Shaded pole FHP motor
List-II
1. Refrigerators
2. Hair dryers
3. Unit heaters
4. Fans, blowers
Codes:

	A	B	C	D
(a)	1	2	4	3
(b)	1	2	3	4
(c)	4	1	2	3
(d)	4	1	3	2

[ESE-2007]

25. An 8-pole single phase induction motor is running at 690 rpm. What is its slip with respect to forward and backward fields, respectively?
(a) 0.08, 2.0 (b) 0.08, 1.92
(c) 1.92, 0.08 (d) 2.0, 0.08

[ESE-2007]

26. Why is centifugal switch used in a single-phase induction motor?
(a) To protect the motor from overloading
(b) To improve the starting performance of the motor
(c) To cut off the starting winding at an appropriate instant
(d) To cut in the capacitor during running conditions

[ESE-2008]

27. Consider the following statements:
1. A synchronous motor has no starting torque but when started it always runs at a fixed speed.
2. A single-phase reluctance motor is not self-starting even if paths for eddy currents are provided in the rotor.
3. A single-phase hysteresis motor is self-starting.

Which of these statement(s) is/are correct?
(a) 1, 2 and 3 (b) 1 only
(c) 1 and 2 only (d) 2 and 3 only

[ESE-2013]

28. The direction of rotation of a single-phase capacitor run induction motor is reversed by
(a) interchanging the terminals of the AC supply.
(b) interchanging the terminals of the capacitor.
(c) interchanging the terminals of the auxiliary winding.
(d) interchanging the terminals of both the windings.

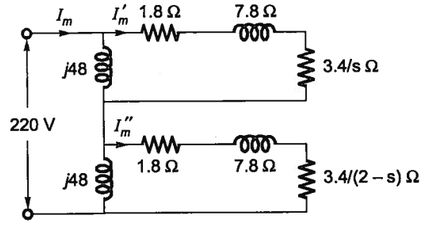
[GATE-2016]

Numerical Data Type Questions

29. A single-stack, eight-phase (stator) multipole, stepper motor has six rotor teeth. The phases are excited one at a time. _____ will be the step size.

Try Yourself

T1. A 220 V, 50 Hz, 4-pole, single-phase induction motor has the following circuit model.



The rotational losses of the motor are estimated to be 75 W. At a motor speed of 940 rpm, _____ A is the magnitude of line current.

[Ans: 5.22]