ELECTRICAL ENGINEERING

Electrical Machines

Multiple Select Questions : Workbook Sheet

Chapter 1.
DC Machines

Q.1 Consider the following statements regarding concentrated winding in electrical machines. Choose, which of these given statement(s) is/are correct?

(a) Concentrated winding is used in field winding of DC machines.

(b) Concentrated winding is generally used in armature of synchronous machines.

(c) Concentrated winding is used in those machines, where number of slots is equal to number of poles.

(d) It can either be full pitch or short pitch.

Q.2 The field winding of DC series motor is provided with thick wire. Which of these given statement(s) is/are correct?

(a) To minimise the voltage drop across field winding.

(b) As it carries large load current.

(c) In order to reduce eddy current to provide large flux.

(d) To minimise the resistance of field winding.

Q.3 Consider the following statements regarding circulating current in DC machines. Which of these given statement(s) is/are correct?

(a) It is associated with LAP winding only.

(b) It reduces the effective copper losses in DC machines.

(c) It can damage the brushes of DC machines.

(d) It reduces the efficiency of machine.

Q.4 A cumulative motor develops a torque of 187.5 N-m and running at 1406.25 rpm. If suddenly series winding is shorted or shunt winding is open circuit. Then which of these given effects can be seen?

[Assume output power to be constant]

(a) EMF will increases

(b) Speed will increases

(c) Torque will decreases

(d) Armature current will decrease

Q.5 A DC shunt motor runs at 750 rpm supplying from and taking a full load line current of 66 A. Its armature and field resistance are 0.4 Ω and 125 Ω respectively. Assume 2 Volt drop across brush and negligible armature reaction. Which of these given statement(s) is/are correct?

(a) No-load base emf for no-load current of 6 A is 248.4 V.

(b) No-load speed for no-load current of 6 A is 822 rpm approx.

(c) The resistance to be added in series with armature circuit to reduce full load speed to 650 rpm is 6 Ω.

(d) Percentage reduction in flux per pole needed so that speed is 800 rpm, when current armature current is 40 A with no external added resistance is approx 2.90.

Q.6 Two DC shunt generators are operating in parallel to share a load current of 200 A. Each generator has armature resistance of 0.1 Ω and field resistance of 100 Ω. Their generated emf are 250 V and 245 V. Which of these given statements is/are correct?

(a) Current shared by generator corresponds to 250 V is 125 A.

(b) Current shared by generator corresponds to 245 V is 75 A.

(c) Power developed by generator corresponds to 245 V is 18.955 kW.

(d) Total field plus armature power losses is 500 Watt.

Q.7 Consider the following statements regarding quadrant operation of DC machines which of these statements is/are correct?
[Assume x-axis to be torque and y-axis to be speed]
(a) In forward motoring mode, both speed and power output is positive.
(b) Fourth quadrant represents the reverse breaking.
(c) In third quadrant, both speed and torque is negative, while power is positive.
(d) In forward braking mode, speed is negative and torque is positive.

Chapter 2. Transformers

Q.1 A 23 kVA, 2300/230 V, 60 Hz, step down transformer has the following resistance and leakage reactance values :
$R_1 = 4\ \Omega$, $R_2 = 0.04\ \Omega$,
$X_1 = 12\ \Omega$ and $X_2 = 0.12\ \Omega$.
The transformer is operating at 75% of its rated load. If the power factor of the load is 0.866 leading.
(a) Source voltage would be 2269.578 V.
(b) Power supplied to the load is 14938.94 W.
(c) Power input is 15389.14 W.
(d) Efficiency of the transformer is 97.1%.

Q.2 A 1-ϕ, 10 kVA, 2200/220 V, 60 Hz transformer has following characteristic.
No-load core loss = 100 Watt
Full load Cu loss = 215 Watt, transformer operate at UPF load.
Which of these given following statement(s) is/are correct?
(a) The maximum efficiency of transformer is approx 97.20%.
(b) Magnitude of current drawn by primary winding, which leads to operate transformer at maximum efficiency is 3.10 Amp.
(c) The equivalent resistance of transformer referred to secondary is 112 Ω.
(d) Percentage load at which Cu loss and iron losses will be equal is 68.20%.

Q.3 When a short circuit test is conducted in a single phase transformer, 30% of the rated voltage is required to allow full load current. The short circuit power factor is found to be 0.2. The percentage regulation at UPF is not equal to
(a) 30 (b) 29.5
(c) 15 (d) 6

Q.4 An ideal transformer has a 150 turn primary and 750 turn secondary. The primary is connected to a 240 V, 50 Hz source. The secondary winding supplies a load of 4 A of a lagging pf 0.8.
Which of the following is/are correct?
(a) $\frac{LV}{HV}$ ratio is 0.2.
(b) Current in the primary is 20 A.
(c) Power supplied to the load is 3840 W.
(d) Maximum flux in the core is 7.21 mWb.

Q.5 A 500 kVA, 11 kV/0.43 kV, 3-ϕ, Δ-Y connected transformer has H.V. side copper loss of 2.5 kW and L.V. side copper loss of 2 kW at rated load. Then the equivalent resistance
(a) on HV side is 6.53 Ω/ph
(b) on LV side is 3.32 mΩ/ph
(c) on HV side is 5.36 Ω/ph
(d) on LV side is 2.23 mΩ/ph

Q.6 When compared to two winding transformers, auto-transformer of same rating has/have
(a) higher leakage reactance.
(b) lower losses.
(c) smaller exciting current.
(d) higher efficiency.

Q.7 The following data were obtained for a 20 kVA, 50 Hz, 2400/240 Volt distribution transformer tested at 50 Hz.

	Voltage (V)	Current (A)	Power (W)
H.V. side open circuited	240	1.038	122
L.V. side short circuited	36.79	5	92.59

Which of these given statement(s) is/are correct?
(a) Full load copper losses of this transformer is 257 watt.
(b) Core loss at half the rated load is 30.5 Watt.

(c) Maximum efficiency of this transformer at unity power factor is 98.26%.

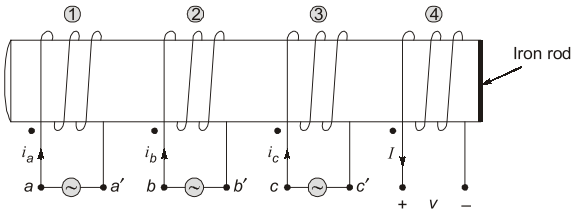
(d) Assume that load power factor is varied while the load current and secondary terminal voltages are held constant, the load power factor for which the voltage regulation is greatest at 0.5033 lagging.

Q.8 Which of the given below transformer connection introduces a phase shift of ±30° between primary and secondary winding voltages.

(a) Y_{d1} (b) Y_{y6}

(c) D_{y1} (d) D_{y11}

Q.9 Consider the figure given below :



$$i_a = I_m \cdot \sin\omega t \cdot \text{A}$$
$$i_b = I_m \cdot \sin(\omega t - 120°)\ \text{A}$$
$$i_c = I_m \cdot \sin(\omega t + 120°)\ \text{A}$$

Each windings have same number of turns.

Which of these following statements's is/are not correct?

(a) Resultant flux in iron rod will have some finite value.

(b) Fundamental flux in iron rod will not equal to zero.

(c) These will induce some voltage in winding (4).

(d) Current I will be zero if winding (4) is short circuited.

Chapter 3. Induction Machine

Q.1 Which of these following capacitor start-split phase induction motor will have largest value capacitance?

(a) 28 Watt, 57 rad/sec

(b) 94 Watt, 3450 rad/sec

(c) 373 Watt, 1140 rad/sec

(d) 560 Watt, 1140 rad/sec

Q.2 A 4-pole, 3-ϕ, SRIM is used as frequency changer. Stator of motor is excited from 3-ϕ, 50 Hz and load requiring 3-ϕ, 20 Hz supply is connected to rotor through slip rings.

At what speed prime mover SRIM should rotates.

(a) 900 rpm (b) 1200 rpm

(c) 1500 rpm (d) 2100 rpm

Q.3 Consider the following statements regards induction motor and choose, which of these statement(s) is/are correct?

(a) The speed of rotor w.r.t. stator is $N_s(1 - s)$ rpm.

(b) The speed of stator w.r.t rotor magnetic field is $-N_s$ rpm.

(c) The speed of rotor magnetic field w.r.t. stator is sN_s rpm.

(d) The speed of stator magnetic field w.r.t. rotor is sN_s rpm.

Q.4 Consider the following statement regarding rotor fed induction motor and choose, which of these statement(s) is/are correct?

(Assume direction of rotation of RMF as positive)

(a) The speed of stator w.r.t. rotor is $N_s(1 - s)$ rpm.

(b) The speed rotor w.r.t. stator RMF is $-N_s$.

(c) The speed of rotor RMF w.r.t. stator RMF is 0

(d) The speed of stator w.r.t. rotor RMF is $-sN_s$.

Q.5 While performing speed control on 3-ϕ induction motor, some amount of emf is injected into rotor circuit through slip rings. Then which of these given statement(s) is/are correct?

(a) Slip will increase

(b) Slip will decrease

(c) Inject emf should have same frequency as that of rotor frequency

(d) Speed will be always greater than base speed

Q.6 A 15 kW, 440 V, 3-ϕ, 6 - pole, 50 Hz, Δ-connected SCIM. If the following data are given for blocked rotor test is 220 V, 25 A, 6 kW, stator core losses at rated voltage and rated frequency is 400 Watt. The resistance measured between any two stator terminal is 0.8 Ω. Then which of these given statement(s) is/are correct?

(a) Speed of rotor is 970 rpm
(b) Rotor resistance will be 0.8 Ω/phase
(c) Input current at rated voltage and frequency in B.R. test is 50 A
(d) Starting torque at rated voltage and frequency is 196.7 N-m.

Q.7 Comparison of double cage induction motor with single cage motor double cage motor has
(a) higher efficiency than single cage motor
(b) higher power factor than single cage motor
(c) lower slip than single cage motor
(d) lower starting current than single cage

Q.8 A 3-ϕ, 50 Hz, 4-pole, delta-connected two cage induction motor has inner cage and outer cage standstill impedances as $(2 + j8)$ Ω/ph and $(9 + j2)$ Ω/ph respectively. The effective rotor voltage being 230 V/ph. Which of these given statements is/are correct?
(a) Gross torque developed at standstill is 136.68 N-m.
(b) Inner cage torque > output cage torque.
(c) Inner cage current at starting is $27.98\angle -34.85°$ Amp
(d) Torque developed by outer cage is 106.97 N-m.

Q.9 A 3-ϕ slip ring induction motor develops a maximum torque of 4-times the full torque at a slip of $s = 0.2$. The per phase rotor resistance is 0.04 Ω. The stator impedance and rotational losses are ignored. What will be the full load slip for given induction motor.
(a) 1.5745 (b) 0.0234
(c) 0.053 (d) 0.0254

Q.10 A 400 V, 50 Hz, 4-pole, 3-ϕ, induction motor is Y-connected has following data.
1. Stator leakage impedance/phase $= (0.5 + \hat{j}1.2)\Omega / \text{ph}$
2. Rotor leakage impedance referred to stator $= (0.3 + j1)$ Ω/ph
3. Full load slip = 0.05

Which of these given statement(s) below is/are correct?
(a) Load torque is the sum of braking torque and plugging torque.
(b) Its initial braking torque soon after plugging is 159.56 N-m
(c) Its load toque is 129.8 N-m.
(d) Its plugging torque is 29.76 N-m.

Chapter 4. Synchronous Machine

Q.1 Consider the following statements about voltage regulation methods in synchronous generator. Which of these given statement(s) is/are incorrect?
(a) EMF method gives higher value of voltage regulation.
(b) MMF method gives lower value of voltage regulations.
(c) ZPF method gives accurate value of voltage regulation.
(d) For ZPF method, emf is handled as ampere turns or field amperes and mmf is handled as voltage.

Q.2 A 3-ϕ, synchronous generator with constant steam input supplies power to infinite bus at lagging power factor. If the excitation now increases then
(a) Both power angle and power factor angle decreases.
(b) Induced emf will increase.
(c) Armature current will increase.
(d) Voltage regulation will improve.

Q.3 A salient pole alternator has $X_d = 1.4$ p.u., $X_q = 1$ p.u. and $R_a = 0$. If this alternator delivers rated kVA at upf, and at rated voltages. Which of these statement(s) is/are correct?
(a) $|E_f| = 1.697$ p.u.
(b) $I_d = 0.707$ p.u.
(c) $\delta = 45°$
(d) If alternator delivers rated kVA at 0.8 leading pf, then load angle (δ) will increases.

Q.4 Consider the following statement regarding synchronous generator. The copper loss in generator is zero. Which of these given below statement(s) is/are correct?

(a) Maximum power output in non-salient generator occurs at $\delta = 90°$.

(b) Maximum reluctance power developed in salient pole synchronous generators at $\delta = 45°$.

(c) Maximum power output in salient pole generators occurs at $\delta < 90°$.

(d) When synchronous generators develops the maximum active power, at the same time it will acts as sink of reactive power.

Q.5 A 9 kVA, 208 V, 1000 rpm, 3-ϕ, 50 Hz, *Y*-connected synchronous generator has following parameters.

(i) Armature winding parameter is $(0.3 + j5)\ \Omega$/phase.

(ii) Field winding resistance is 4.5 Ω.

(iii) Rotational losses are 500 Watt.

The field winding current is 5 A, when the generator operates at full load 0.8 pf lag.

Which of these statement(s) is/are correct?

(a) Generated voltage/phase will be 222.43 Volt.

(b) Its efficiency will be approx 85.97%.

(c) Torque developed by the generator will be 74.11 N-m.

(d) Voltage applied at field winding is 25 V.

Q.6 Consider the following statements for salient pole machine and choose, which of these statement(s) given below is/are correct?

(a) We can replace armature reaction by a physical parameter X_{ar} (armature reaction reactance) in salient pole machines.

(b) When the rotor lies along a phase, the induced emf and corresponding phase current will be maximum.

(c) *d*-axis armature mmf will face minimum reluctance.

(d) *q*-axis armature mmf will face maximum reluctance.

Q.7 Consider the following statements regarding synchronous machines and choose, which of these statement(s) is/are correct?

(a) When synchronous motor is over excited, its back emf is less than the supply voltage.

(b) When synchronous motor is overexcited, then its p.f. is leading.

(c) Synchronous motor is used as capacitor, where load is so large such that construction of static capacitor is impractical.

(d) The load angle (δ) of synchronous motor is generally negative.

Q.8 A 3-ϕ, 1500 kW, *Y*-connected, 4 kV, 48 pole, 50 Hz synchronous motor with synchronous reactance of the 4 Ω/phase and operating at 0.8 pf lag, then which of these given statement(s) given below is/are not correct?

(a) Maximum power developed by motor is 4271.2 kW.

(b) Load angle (δ) of motor is –27.55°.

(c) Its internal p.f. is 0.8 lead.

(d) It's field flux leads the resultant flux.

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