Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem Examination May-2024

EE3CO37 Electrical Machines -II

Programme: B.Tech. Branch/Specialisation: EE

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. In D.C Generators, lap winding is used for- **1**
(a) High voltage, high current
(b) Low voltage, high current
(c) High voltage, low current
(d) Low voltage, low current

ii. The demagnetizing component of armature reaction in a D.C Generator- **1**
(a) Reduces generator e.m.f
(b) Increases armature speed
(c) Reduces interpoles flux density
(d) Results in sparking trouble

iii. The speed of DC shunt motor can be increased above rated speed by- **1**
(a) Increasing the resistance in the armature circuit
(b) Increasing the resistance in the field circuit
(c) Reducing the resistance in the field circuit
(d) Reducing the resistance in the armature circuit

iv. Starters are used with DC motors because- **1**
(a) These motors have high starting torque
(b) These motors are not self-starting
(c) To restrict armature current as there is no back emf while starting
(d) None of these

v. What is the supply frequency of a synchronous generator having 6 poles runs at 1000 r.p.m? **1**
(a) 25 Hz (b) 40 Hz
(c) 50 Hz (d) 60 Hz

P.T.O.

vi. What is the name of the equipment that provides DC to the rotor of synchronous generator? **1**
(a) Exciter (b) Inverter (c) Rectifier (d) Synchronizer

vii. Separate damper winding is necessary in - **1**
(a) Cylindrical rotor type synchronous generator
(b) Salient pole rotor type synchronous generator
(c) Both (a) and (b)
(d) None of these

viii. Which type of synchronous generator is used in hydroelectric power plant? **1**
(a) Non salient pole (b) Turbo
(c) Salient pole (d) Steam turbine

ix. In which of the following motors the stator and rotor magnetic field rotate at the same speed? **1**
(a) Universal motor
(b) Synchronous motor
(c) Reluctance motor
(d) Induction motor

x. Which of the following methods is used to start a synchronous motor? **1**
(a) Damper winding
(b) Star-delta starter
(c) Damper winding in conjunction with star-delta starter
(d) None of these

Q.2 i. Write down the functions of the following parts of a DC generator: **2**
(a) Pole shoe
(b) Commutator

ii. Draw and explain the magnetization (no-load) characteristics of D.C shunt generator. **3**

iii. Derive the E.M.F equation of DC generator. **5**

OR iv. A 4-pole DC generator, having wave wound armature winding has 51 slots, each containing 20 conductors. What will be the voltage generated in the machine when driven at 1500 r.p.m assuming the flux per pole to be 7.0 mWb? **5**

Q.3 i. Why starter is required in a DC motor? Explain. **2**

ii. With neat sketch, describe the armature resistance and field flux speed control methods of DC shunt motor in details. **8**

OR iii. A 500V shunt motor runs at its normal speed of 250 r.p.m, when the armature current is 200A. The resistance of armature is 0.12 ohm. Calculate the speed when a resistance is inserted in the field reducing the shunt field to 80% of normal value and the armature current is 100 ampere. **8**

Q.4 i. What is short circuit ratio of synchronous generator? Explain its effect on the performance of the generator. **3**

ii. What do you understand by voltage regulation of synchronous generator? Describe in detail, the ZPF (potier triangle) voltage regulation method of synchronous generator. **7**

OR iii. A 100KVA, 3000V, 50Hz, 3-phase star connected synchronous generator has effective armature resistance of 0.2 ohm. The field current of 40 A produces short circuit current of 200A and an open circuit voltage of 1040 V (line value). Calculate the full-load voltage regulation at 0.8 p.f lagging and at 0.8 p.f leading using synchronous impedance method. **7**

Q.5 i. What is hunting in salient pole synchronous generator? How effects of hunting can be minimized? **4**

ii. Describe the two reaction theory of salient pole synchronous generator and draw its equivalent circuit. **6**

OR iii. Derive the power angle equation of 3-phase salient pole synchronous generator and draw its power angle characteristics. **6**

Q.6 Attempt any two:

i. What is V-curve and inverted V-curve of a synchronous motor? Explain, how does field excitation of a synchronous motor controls the reactive power supplied to or consumed by the power system? **5**

ii. Define efficiency of synchronous motor. What are the different types of losses present in a synchronous motor? Explain in detail. **5**

iii. Write short note on BLDC motor. **5**

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Scheme of Marking

MEDI-CAPS UNIVERSITY Knowledge Is Power	Faculty of Engineering End Sem Examination May-2024 Electrical Machines -II (T) - EE3CO37 (T)
Programme: B.Tech.	Branch/Specialisation: Electrical Engineering

Note: The Paper Setter should provide the answer wise splitting of the marks in the scheme below.

Q.1	i)	(b) Low voltage, high current	**1**
	ii)	(a) Reduces generator e.m.f	**1**
	iii)	(b) Increasing the resistance in the field circuit	**1**
	iv)	(c) To restrict armature current as there is no back emf while starting	**1**
	v)	(c) 50 Hz	**1**
	vi)	(a) Exciter	**1**
	vii)	(b) Salient pole rotor type synchronous generator	**1**
	viii)	(c) Salient pole	**1**
	ix)	(b) Synchronous motor	**1**
	x)	(c) Damper winding in conjunction with star-delta starter	**1**
Q.2	i.	Functions of pole shoe-01, Functions of commutator-01	**2**
	ii.	Draw (characteristics)-01, Define & explain (characteristics)-02	**3**
	iii.	Derivation upto final expression-05 (only writing expression by defining all quantities-02)	**5**
OR	iv.	Total number of conductors calculation-01, Voltage expression-01, Voltage calculation-03	**5**
Q.3	i.	Explanation-02	**2**
	ii.	(a) **Armature resistance control** (Circuit diagram-02, explanation-02) (b) **Field flux control** (Circuit diagram-02, explanation-02)	**8**
OR	iii.	Case-I (back emf calculation-01,writing different given parameter values-01) Case-II (back emf calculation-01, writing different given parameter values-01, Relationship of flux in first and second case-01, back emf & speed relationship-01, calculation of speed-02)	**8**
Q.4	i.	Definition-02, explanation-01	**3**
	ii.	Definition of VR-01, OCC-01, ZPF characteristics-01, drawing of potier triangle-02, explanation-01, voltage regulation expression-01	**7**
OR	iii.	Calculation of Zs-01, VR calculation for 0.8 p.f lagging-03, VR calculation for 0.8 p.f leading-03	**7**
Q.5	i.	Hunting explanation-03, methods to reduce-01	**4**
	ii.	Two reaction theory (explanation)-04, equivalent circuit-02	**6**
OR	iii.	Derivation-04, characteristics-02	**6**
Q.6			
	i.	V-curve & inverted V-curve (definition)-02, Explanation for reactive power control-03	**5**
	ii.	Efficiency (definition)-01, List of types of losses-01, explanation of various losses-03	**5**
	iii.	BLDC (diagram-02), explanation-03	**5**

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End sem Examination May-2014

EM-II (EE3C037)

Q2) (ii) Induced emf $[E] = \frac{\phi Z N P}{60 A}$.

Given that: Total no of conductors (Z)

= slots × conductors per each slot

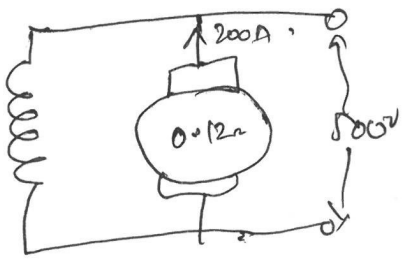
$Z = 51 \times 20 = 1020$

$P = 4$, $\phi = 0.007$ wb , $A = 4$; $N = 1500$ r.p.m.

$$E = \frac{1500 \times 4 \times 0.007 \times 1020}{60 \times 4}$$

$= 178.5$ V

Q3) (iii)



Given that:

Supply voltage = 500V

$N_1 = 280$ rpm.

$I_{a_1} = 200$ A

$R_a = 0.12\Omega$.

Back emf of dc motor $\Rightarrow E_b = V - I_a R_a$

$E_b = 500 - 200 \times 0.12 = 478$ V

When resistance is inserted in field., flux reduced to 80%

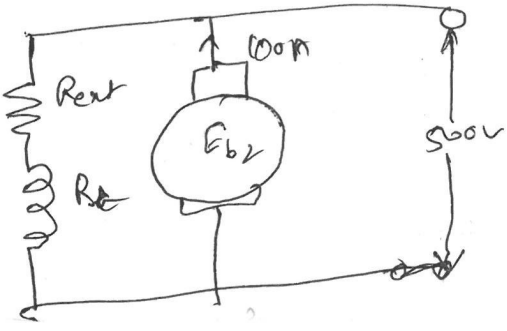
$\phi_2 = 0.8\phi_1$

$I_{a_2} = 100$ A.

Now $E_{b_2} = V - I_a R_a$

$= 500 - 100 \times 0.12$

$= 488$ V.



& $E_b \propto N\phi$

$$\frac{E_{b2}}{E_{b1}} = \frac{N_2}{N_1} \times \frac{\phi_2}{\phi_1}$$

$$N_2 = N_1 \times \frac{E_{b2}}{E_{b1}} \times \frac{\phi_1}{\phi_2}$$

$$= 250 \times \frac{418}{476} \times \frac{\phi_1}{0.8\phi_1}$$

$$= 320 \text{ rpm}$$

(Q4) (iii)

$$I = \frac{100 \times 10^3}{\sqrt{3} \times 3000} = 19.25 \text{ A}$$

$$V_{ph} = V_L/\sqrt{3} = \frac{3000}{\sqrt{3}} = 1732 \text{ V}$$

$$E_{ph} = 1040/\sqrt{3} = 600.45 \text{ V}$$

$$Z_s = E_{ph}/I_{sc} = 600.45/200 = 3\Omega$$

$$X_s = \sqrt{Z_s^2 - R_a^2} = \sqrt{3^2 - 0.2^2} = 2.99\Omega$$

$$E_L = \sqrt{(V_{ph}\cos\phi + I_a R_a)^2 + (V_{ph}\sin\phi - I_a X_s)^2} \quad \text{(for leading p.f)}$$

$$= \sqrt{(1732 \times 0.8 + 19.45 \times 0.2)^2 + (1732 \times 0.6 - 19.25 \times 2.99)^2}$$

$$= 1701.23$$

$$\%\text{ Regn} = \frac{E - V}{V} \times 100 = \frac{1701.23 - 1732}{1732} \times 100$$

$\%\text{ Regn} = -1.776\ \%$ for leading

For lagging p.f:

$$E = \sqrt{(V_{ph}\cos\phi + I_a R_a)^2 + (V_{ph}\sin\phi + I_a X_s)^2}$$

$$= 1770.154 \text{ V}$$

$$\%\text{ Regn} = \frac{1770.154 - 1732}{1732} \times 100 = 2.20\%$$

$\%\text{ Regn} = 2.20\%$