Total No. of Questions : 8]

SEAT No. :

**PE-4241**

[Total No. of Pages : 3

# [6582]-12
# S.E. (Electrical Engineering)
# ELECTRICAL MACHINES - I
# (2019 Pattern) (Semester - IV) (203146)

*Time : 2½ Hours]* *[Max. Marks : 70*

***Instructions to the candidates:***

1) ***Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.***
2) ***Neat diagrams must be drawn whenever necessary.***
3) ***Figures to the right additional indicate full marks.***
4) ***Assume suitable data if necessary.***
5) ***Use of a non-programmable Calculator is allowed.***

***Q1)*** a) Draw the diagram showing the constructional details of the DC machine. Label all the parts. Write the functions and the material used for the following parts. **[9]**

i) Commutator

ii) Interpole

b) A 500 V DC Shunt Motor has an armature resistance of 1 ohm and a shunt field resistance of 300 ohm. On no load, it runs at 1000 RPM and draws a current of 4A from the supply. Find the speed of the motor when it is loaded and takes a current of 25 A. Also, find its speed when an additional resistance of 2.3 ohm is connected with the armature. The current taken by the motor in this condition is 25A. **[9]**

OR

***Q2)*** a) Derive the torque equation of the DC motor. Name the various torques of DC Motor. **[9]**

b) A 500 V 6 Pole DC shunt motor has the armature and the shunt field resistance of 1 ohm and 300 ohms respectively. It draws a total current of 25 A from the supply. If the rotational losses are 900 watts. Calculate the efficiency of the motor. Also, find the back EMF generated at full load condition. **[9]**

***P.T.O.***

***Q3)*** a) Draw and explain the following characteristics of the DC series Motor: **[9]**

i) Torque vs. armature current

ii) Speed vs. armature current

iii) Speed vs. torque

b) Compare the armature voltage control method with the field current control method of speed control of the DC motor. **[8]**

OR

***Q4)*** a) What is the necessity of the starter in a DC motor? Explain with a neat labeled sketch the working of a three-point starter. **[9]**

b) A DC shunt motor operating on a 220 V supply draws a current of 28 Amp and runs at 1000 RPM. Its armature resistance is 1 ohm and its field resistance is 150 ohm. Calculate the

i) additonal resistance to be inserted in series with armature to reduce the speed to 700 RPM keeping the load constant.

ii) Find the speed of the motor if the 25-ohm resistance is inserted in series with the field winding. **[8]**

***Q5)*** a) Draw a power flow diagram of a 3-phase induction motor. Write respective mathematical expressions for each stage. **[6]**

b) Derive the relationship between rotor input, rotor copper loss and gross mechanical power developed. **[8]**

c) Define the slip of an Induction Motor. What are the effects of slip on rotor parameters of an Induction Motor. **[4]**

OR

***Q6)*** a) The power input to a 440 V, 50 Hz, 6 pole three phase Induction motor running at 980 RPM is 40kW. The stator lossers are 1.25kW and friction and windage losses are 2kW. Find **[6]**

i) the slip

ii) the rotor copper losses

iii) the efficiency of the motor

b) Prove the following **[8]**

i) $\frac{T_{st}}{T_{\max}} = \frac{2a}{1+a^2}$

ii) $\frac{T_{fl}}{T_{\max}} = \frac{2as_{fl}}{a^2+s_{fl}^2}$

c) Sketch the torque-slip characteristics of a 3-phase induction motot. Mark the following torque points on it. **[4]**

i) Starting Torque

ii) Maximum torque

***Q7)*** a) State the types of starters used for induction motors. Explain the DOL starter with a suitable diagram. **[9]**

b) With a suitable curcuit diagram explain the No load Blocked rotor test carried out on a 3-phase induction motor. Also, write the respctive formulae involved in the calculation part for determining the equivalent circuit parameters. **[8]**

OR

***Q8)*** a) Explain the testing of 3-phase induction motors by IS 325 and IS 4029. **[8]**

b) Sketch and explain the step-by-step procedure of the circule diagram of the 3-phase induction motor. Indicate the following quantities in it. **[9]**

i) No Load Current

ii) Output line

iii) Rotor copper Loss

iv) Torque line

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