Total No. of Questions : 8]

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S.E.(Automobile & Mechanical/Mechanical Sandwich)

ELECTRICAL AND ELECTRONICS ENGINEERING

(2019 Pattern) (Semester - III) (203156)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.***
2) ***Figures to the right indicate full marks.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Assume suitable data, if necessary.***
5) ***Use of non-programmable calculator is allowed.***

Q1) a) Derive the emf equation of a DC machine; mentioning about all the parameters involved. **[6]**

b) A 250 V, 4 pole lap wound DC shunt motor takes no-load current of 4 A when running at 1200 rpm. The resistance of armature winding is 0.1 Ω and shunt field winding is 125 Ω. The brush drop is 2 V. If it takes current of 61 A on full-load, calculate its full-load speed. Assume that the flux gets weakened by 5% on full- load condition due to armature reaction. **[6]**

c) How is the direction of rotation of a DC shunt motor reversed? Discuss the concept of load torque and hence explain the dynamics of motor and load combination briefly. **[6]**

OR

Q2) a) Explain the following methods of controlling speed of a DC shunt motor; mentioning each of their application: **[6]**

i) Flux control method

ii) Armature voltage control method

b) A 200 V, 4 pole lap wound DC shunt motor has 800 conductors on its armature. The resistance of armature winding is 0.5 Ω and that of shunt field winding is 200Ω. The motor takes current of 21 A and flux per pole is 30 mWb. Find the speed and gross torque developed in motor. **[6]**

c) Explain regenerative braking in a DC shunt motor with the help of neat diagrams. Also enlist any two applications of regenerative braking. **[6]**

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Q3) a) Differentiate between squirrel cage and slip ring type induction motors; mentioning significant points. **[6]**

b) A 4 pole, 50 Hz, three phase induction motor has rotor resistance and reactance of 0.025 Ω and 0.1 Ω respectively. Determine **[6]**

i) synchronous speed

ii) the speed and the corresponding slip at which maximum torque occurs

iii) the additional resistance per phase that must be connected in series with the rotor to obtain maximum torque at starting

iv) the value of slip at which maximum torque occurs and corresponding speed if an external resistance of 0.025 Ω is connected in series with the rotor.

c) Describe in brief the voltage control method for the speed control of a three phase induction motor. **[5]**

OR

Q4) a) Derive the generalised torque equation of a three phase induction motor and hence obtain the condition for maximum torque. **[6]**

b) The useful full load torque of a three phase, 6 pole, 50 Hz induction motor is 162.84 N-m. The rotor is running at a speed of 970 rpm. Calculate **[6]**

i) motor output

ii) copper losses in rotor

iii) % efficiency of the motor, if mechanical torque lost in windings and friction is 20.36 N-m and stator losses are 830 W.

c) Draw a neat sketch and explain the operation of a Direct On Line (DOL) type starter used for starting a three phase induction motor. **[5]**

Q5) a) Elaborate the functioning of main subsystems of an Electric Vehicle (EV). **[6]**

b) Discuss the major challenges faced by EV Technology for its growth. **[6]**

c) Explain the impact made by usage of EVs on power grid. **[6]**

OR

Q6) a) Define Electric Vehicle (EV). State its types and explain any one type of EV. **[6]**

b) Explain configuration of Series Hybrid Vehicle and state its advantages and disadvantages. **[6]**

c) Explain Vehicle to Grid (V2G) Technology with the help of block diagram. **[6]**

Q7) a) Elaborate construction and working of Lithium Iron Phosphate (LFP) battery. **[6]**

b) Explain use of a supercapacitor in an EV; stating its necessity and advantages. **[6]**

c) Explain Vehicle Battery Management System (BMS) with the help of block diagram. **[5]**

OR

Q8) a) Elaborate the factors used in selection of energy storage devices in case of EVs. **[6]**

b) Explain characteristics and speed control of BLDC motor. **[6]**

c) Discuss the working of hydrogen fuel cell and its suitability in EVs. **[5]**