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THIRD SEMESTER **B.Tech.(EE/EL)**

SUPPLEMENTARY EXAMINATION **FEB-2019**

EE/EL-205 Electromechanical Energy Conversion and Transformers

Time: 3:00 Hours *Max. Marks: 40*

Note: Answer ***ALL EIGHT*** questions. All carry equal marks. Use graph paper if necessary. Assume suitable missing data, if any.

Q (1) Consider the solenoid shown in Fig.1. Let the coil have a resistance R and be excited by a voltage $v = V_m \sin \omega t$. For a displacement g_0 between the plunger and the coil (pole face), determine the steady state (i) coil current (ii) electric force

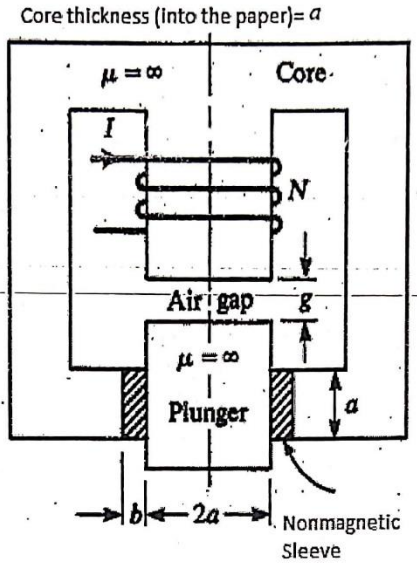

Fig. 1

Q(2) List out any eight differences between Lap and Wave Winding. Prepare the winding table for the Lap winding for the following parameters: Number of slots s= 16, Number of poles 2p= 4, Number of parallel paths 2a= 4, Number of coil sides in upper layer of a slot u= 1, Number of turns per coil N_c=1.

Q(3) A 60-kW, 960-rpm, 230-V, 260.2-A DC generator operates as a separately-excited generator at nominal speed and nominal voltage feeding an external circuit with such resistance that the current drawn by the load is equal to the nominal armature current. Resistances of winding at steady temperature and nominal operation are: armature winding resistance $R_a = 0.035\Omega$ and resistance of inter pole winding $R_{int} = 0.015\Omega$. The brush voltage drop is $\Delta V_{BR} = 2\ V$. Assuming constant field excitation current, find the armature terminal voltage, current and delivered power to the external load for the speed of prime mover decreases 15%.

Q(4) Derive the EMF equation for a generator from basic operating principles. The two plots of Fig.2 show the **OCC** for a **600-V,** 1200 rpm dc machine where the data were recorded at 1200 and 800 rpm. Explain how if only one of the curves were available, the second could be generated.

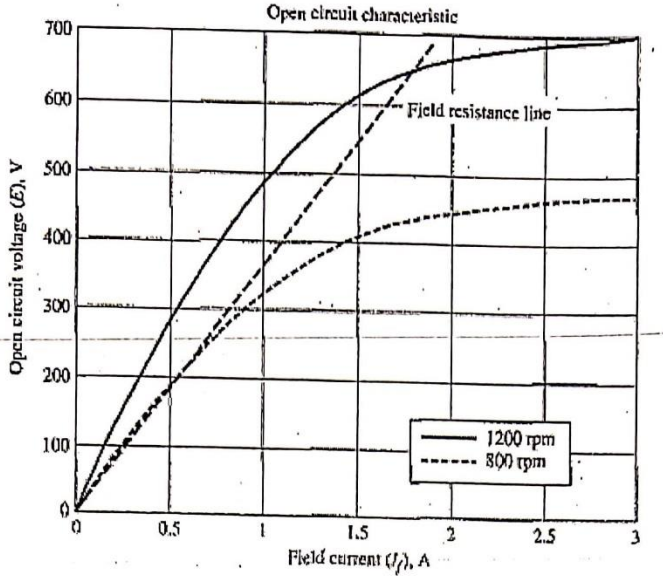

Fig. 2

Q(5) Discuss the method of speed control of a dc shunt motor. A 10-hp, 230V shunt motor takes a full load line current of 40A. The armature and field resistances are 0.25 Ω and 230 Ω respectively. The total brush contact drop is 2V and the core and friction losses are 380W.Calculate the efficiency of the motor. Assume that the stray load losses is 1% of output.

Q(6) Draw and explain the vector diagram of a single phase transformer supplying with a (i) lagging load (ii) leading load . The following 60-Hz data were recorded for a 480:240-V, 25-kVA, 60-Hz transformer with windings and core at approximately normal operating temperatures: In addition, the dc resistances of the two windings were measured and the values found to be $R_{1dc} = 0.110\Omega$ and $R_{2dc} = 0.029\Omega$. Determine the values of the equivalent circuit elements.

Test	Voltage (V)	Current (A)	Power (W)
OC test (Low side)	240	9.7	720
SC test (High side)	37.2	51.9	750

Q(7) Draw the vector diagrams and winding connections of vector group 2 for Y_{y6}, D_{d6}, D_{z6}. A three phase step down transformer is connected to 6.6 kV supply mains and takes 80A. Calculate its secondary line voltage and line current for the Y-Δ if the ratio of turns per phase is 16.

Q(8) Draw the vector diagram of an auto transformer operating on unity power factor load. An auto transformer is used to step-down voltage level from 230V to 200V. While the load is 20kW at UPF, neglecting the losses and magnetizing current, find the current in different sections of the winding.

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