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BIEE-008

B.Tech. – VIEP – ELECTRICAL ENGINEERING (BTELVI)

Term-End Examination

00126

June, 2014

BIEE-008 : ELECTRO-MECHANICAL ENERGY CONVERSION - I

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any* ***seven*** *questions out of ten. Use of scientific calculator is allowed. Assume suitable assumption if needed.*

1. (a) State the advantages of analysing energy-conversion devices by field-energy concept. 5

(b) An air cored coil is required to be 3·5 cm long and to have an average cross-sectional area of 3 cm^2. The coils should have an inductance of 700 μH. Find the number of turns needed. 5

2. (a) Distinguish between singly-excited and doubly-excited magnetic systems. 5

(b) In a doubly-excited rotary machine, the inductance coefficients are

$$L_{11} = 1{\cdot}1 + 0{\cdot}4 \cos 2\theta$$

$$L_{22} = 0{\cdot}03 + 0{\cdot}005 \cos 2\theta$$

$$L_{12} = 0{\cdot}2 \cos \theta$$

The exciting currents are $i_1 = 8$ A and $i_2 = 50$ A. Obtain the torque/angular displacement relation. *5*

3. (a) What is armature reaction ? How does it affect the operation of a d.c. machine ? *5*

(b) Explain the concept of electrical degrees. How is the electrical angle of the voltage in a rotor conductor related to the mechanical angle of the machine's shaft ? *5*

4. (a) What are compensating windings ? What is their most serious disadvantage ? *5*

(b) Derive the equation for emf generated in the armature of d.c. generator. *5*

5. (a) Describe with a neat diagram, the working of a three-point starter used for a d.c. shunt motor. *5*

(b) Describe Hopkinson's test for two identical d.c. shunt machines coupled mechanically. *5*

6. (a) Discuss the effect of speed and size on the efficiency of d.c. machines. *5*

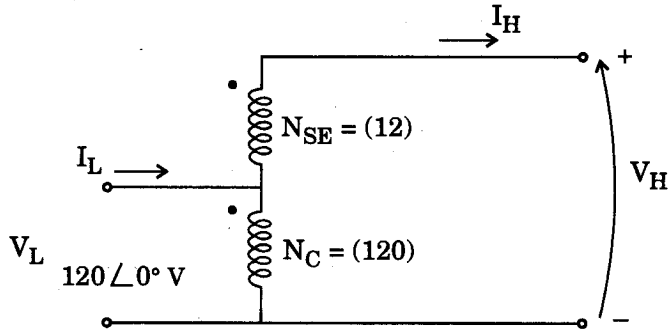
(b) Draw a block diagram showing the dynamic behaviour of a separately excited d.c. motor. Derive the necessary equations on which the diagram is based. *5*

7. (a) List and describe the types of losses that occur in a transformer with the help of equivalent circuit model. 5

(b) Draw and explain no-load phasor diagram of a single phase transformer. 5

8. (a) Describe the short-circuit (SC) test for single phase transformer. Why does the SC test essentially show only i^2R losses and not excitation losses in transformer ? 5

(b) A 100 VA, 120/12 V transformer is to be connected so as to form a step-up autotransformer (see fig.). A primary voltage of 120 V is applied to the transformer.



(i) What is the secondary voltage of the transformer ?

(ii) What is the maximum volt-ampere rating in this mode of operation ?

(iii) Calculate rating advantage of this autotransformer over the conventional transformer's rating in 120/12 V operation. 5

9. (a) Discuss the points of similarity in transformers and rotating electrical machines. *5*

(b) What happens to a transformer when it is first connected to a power line ? Can anything be done to mitigate this problem ? *5*

10. (a) Discuss any two ways of connection of three-phase transformers with relevant relations amongst voltages and currents. *5*

(b) A 20 KVA, 20,000/480 V, 60 Hz distribution transformer is tested with the following results :

Open-circuit test (measured from secondary)	Short-circuit test (measured from primary)
V_{OC} = 480 V	V_{SC} = 1130 V
I_{OC} = 1·51 A	I_{SC} = 1·00 A
P_{OC} = 271 W	P_{SC} = 260 W

Find the per unit equivalent circuit of this transformer at 60 Hz. *5*