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# EE 131304

Roll No. of candidate | | | | | | | | | | |

**2017**

**B.Tech. 3rd Semester End-Term Examination**

**Electrical**

**ELECTRICAL MACHINES – I**

Full Marks – 100 Time – Three hours

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The figures in the margin indicate full marks for the questions.

Answer Question No. 1 and any *six* from the rest.

1. Answer the following questions : (10 × 1 = 10)

   (a) The armature of a dc machine is made up of

   (i) Silicon steel

   (ii) Wrought iron

   (iii) Cast steel

   (iv) Soft iron

   (b) In simplex wave winding, the number of parallel path is equal to

   (i) Number of poles in the machine

   (ii) 2

   (iii) Number of pairs of poles

   (iv) None of the above

**[Turn over**

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(c) The emf induced in the armature winding of DC generator is

(i) AC

(ii) DC

(iii) Both AC and DC

(iv) None of the above

(d) In a dc machine 72 coils are used. The number of commutator segment required is

(i) 72

(ii) 36

(iii) 38

(iv) 74

(e) A 10 pole lap wound generator has 500 conductors; the emf induced per conductor is 5 V. The generated voltage of the generator is

(i) 2500 V

(ii) 1000 V

(iii) 250 V

(iv) None of the above

(f) DC shunt motor are used in such applications where ———————— is required.

(i) High starting torque

(ii) Practically constant speed

(iii) High no load speed

(iv) Variable speed



(g) The primary and secondary of a transformer are coupled

(i) Electrically

(ii) Magnetically

(iii) Both electrically and magnetically

(iv) None of the above

(h) A transformer transfers electrical energy from primary to secondary side usually with a change in

(i) Frequency

(ii) Power

(iii) Voltage

(iv) Time period

(i) Thin laminations are used in machines in order to reduce

(i) Eddy current loss

(ii) Hysteresis loss

(iii) Both (i) and (ii)

(iv) None of the above

(j) $R_1$ is the resistance of the primary winding of the transformer. The turns ratio in terms of primary to secondary is $k$. Then the equivalent resistance of the primary referred to the secondary is

(i) $\frac{R_1}{k}$

(ii) $k^2 R_1$

(iii) $\frac{R_1}{k^2}$

(iv) $kR_1$

2. (a) Explain the principle of electro-mechanical energy conversion. What is energy balance equation? (5)

(b) Why is the armature winding placed in the rotor of a DC machine? (2)

(c) A DC generator has an armature with 90 slots and in each slot a coil is present with 4 turns. Calculate the no of active conductors. (3)

(d) An 8 pole lap wound armature rotated at 350 rpm is required to generate 260 V. The useful flux per pole is 0.05 Wb. If the armature has 120 slots, calculate the number of conductors per slot. (5)

3. (a) Draw a neat sketch of a DC generator. State the functions of each part. (3 + 7)

(b) Derive the emf equation of a DC generator. (5)

4. (a) A 120 V compound generator, the resistance of the armature, shunt and series winding are 0.06 Ω, 25 Ω and 0.04 Ω respectively. The load current is 100 A at 120 V. Find the armature current and induced emf when the machine is connected as

(i) Long shunt

(ii) Short shunt. (5)

(b) The Hopkinson's test on two identical shunt machines gave the following results:

Input voltage = 500 V

Input current = 15 A



Output current of generator = 120 A

Field current of generator = 4 A

Field current of motor = 3 A

Armature resistance of each machine = 0.06 Ω

Find the efficiency of motor and generator. (10)

5. (a) What are the various losses present in a DC machine? State the condition for maximum efficiency of DC machines. (6)

(b) Explain back or counter emf. (3)

(c) Explain any one method of speed control of DC series motor. (3)

(d) A 220V DC shunt motor runs at 500 r.p.m. when the armature current is 50 A. Calculate the speed if the torque is doubled. The armature resistance of the motor is 0.2 Ω. (3)

6. (a) Explain the principle of operation of a transformer. Why a transformer cannot work on DC supply? (4)

(b) Draw the phasor diagram of a practical transformer with core losses. (4)

(c) Derive the emf equation of a transformer. (3)

(d) An ideal 25 KVA transformer has 500 turns on the primary winding and 40 turns on the secondary winding. The primary is connected to 3000 V, 50 Hz supply. Calculate (4)

(i) Primary and secondary currents on full load

(ii) Secondary emf

(iii) Maximum core flux.

7. (a) A 4500/16000 V, 1500 KVA, 50 Hz transformer has the following parameters :

$R_1 = 0.03\Omega \quad R_2 = 0.44\Omega \quad R_0 = 1688\Omega$

$X_1 = 0.092\Omega \quad X_2 = 1.34\Omega \quad X_0 = 256\Omega$

The transformer is supplying full load at a power factor of 0.8 lagging. Using exact equivalent circuit, find the input current. (7)

(b) A 2300/230V, 500 KVA, 50 Hz distribution transformer has core loss of 1600 W at rated voltage and copper loss 7.5 KW at full load. During the day it is loaded as follows :

| % load | 0% | 20% | 50% | 80% | 100% | 125% |
|---|---|---|---|---|---|---|
| Power factor | – | 0.7 lag | 0.8 lag | 0.9 lag | 1 | 0.85 lag |
| Hours | 2 | 4 | 4 | 5 | 7 | 2 |

Determine the all-day efficiency of the transformer. (8)

8. (a) What are the various losses that occur in a transformer? Derive the condition for maximum efficiency. (5)

(b) Derive an expression for saving of copper in autotransformer. (5)

(c) State the necessary conditions for parallel operation of single phase transformer. (3)

(d) Why should the secondary of a current transformer never be left open? (2)



9. Write a note on any three of the following : (3 × 5)

(a) Armature reaction for DC generator

(b) Three point starter for DC motor

(c) Core type and shell type transformer

(d) Operating principle of brushless DC motor

(e) Stepper motor.