Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 40999

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018
Fourth Semester
Electrical and Electronics Engineering
EE 6401 – ELECTRICAL MACHINES – I
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A (10×2=20 Marks)

1. What are the types of magnetic losses ?
2. How are hysteresis and eddy current losses minimized ?
3. Full load copper loss in a transformer is 1600 W, what will be the loss at half load ?
4. Give the condition to be satisfied for parallel operation of transformer.
5. Why the relationship between current and coil flux linkages of electromechanical energy conversion devices are linear ?
6. What are the causes for irrecoverable energy loss when the flux in the magnetic circuit undergoes a cycle ?
7. Why the armature core in d.c. machines is constructed with laminated steel sheets instead of solid steel sheets ?
8. Draw and explain the magnetising characteristics of DC shunt generator.
9. How will you change the direction of rotation of d.c. motor ?
10. Why commutator is employed in d.c. machines ?

PART – B (5×13=65 Marks)

11. a) An iron rod 1.8 cm diameter is bent to form a ring of mean diameter 25 cm and wound with 250 turns of wire. A gap of 1 mm exists in between the end faces. Calculate the current required to produce a flux of 0.6 mWb. Take relative permeability of iron as 1200. (13)

(OR)

b) An electromagnetic relay has an exciting coil of 800 turns. The coil has a cross section of 5 cm × 5 cm. Find (a) coil inductance if the air gap length is 0.5 cm. (b) field energy stored for a coil current of 1.25 A (c) Permeance at air gap. **(13)**

12. a) The emf per turn of a single phase, 6.6 kV/440 V, 50 Hz transformer is approximately 10V. Calculate the number of turns in the HV and LV windings and the net cross sectional area of the core for a maximum flux density of 1.6 T. **(13)**

(OR)

b) A 11000/230 V, 150 kVA, 1-phase, 50 Hz transformer has core loss of 1.4 kW and F.L. copper loss of 1.6 kW. Determine (i) The kVA load for maximum efficiency and the value of maximum efficiency at unity p.f. (ii) The efficiency at 0.8 pf leading. **(13)**

13. a) Two coupled coils have self and mutual inductance of $L_{11} = 3 + 0.5x$; $L_{22} = 2 + 0.5x$; $L_{12} = L_{21} = 0.3x$ over a certain range of linear displacement x. The first coil is excited by a constant current of 15A and the second by a constant current of –8A. Determine : (i) Mechanical work done if x changes from 0.6m to 1 m (ii) Energy supplied by each electrical source. **(13)**

(OR)

b) Consider an attracted armature relay is excited by an electric source. Explain about the mechanical force developed and the mechanical energy output with necessary equations for linear and non linear cases. **(13)**

14. a) Two 500 V DC shunt generators rated at 100 kW and 200 kW respectively are operating in parallel. Both of them have linearly drooping external characteristics. Voltage regulation of the first generator is 4% and that of the second generator is 6%. Determine the common bus voltage and current shared by each of the generators when their parallel combination is to supply a current of 300A. **(13)**

(OR)

b) A 4-pole, 50 kW, 250 V, wave wound shunt generator has 400 armature conductors. Brushes are given a lead of 4 commutator segments. Calculate the demagnetization ampere-turns per pole if shunt field resistance is 50 ohm. Also, calculate extra shunt field turns per pole to neutralize the demagnetization. **(13)**

15. a) A 440 V D.C. shunt motor takes 4A at no load. Its armature and field resistances are 0.4 ohms and 220 ohms respectively. Estimate the kW output and efficiency when the motor takes 60A on full load. **(13)**

(OR)

b) Determine developed torque and shaft torque of 220V, 4 pole series motor with 800 conductors wave-connected supplying a load of 8.2 kW by taking 45A from the mains. The flux per pole is 25m/Wb and its armature circuit resistance is 0.6 Ω. **(13)**

PART – C (1×15=15 Marks)

16. a) A 20 kVA, 2000/200V, 50Hz, single-phase transformer has the following parameters :
$r_1 = 2.8\ \Omega$, $r_2 = 0.02\ \Omega$, $x_{11} = 4.2\ \Omega$ and $x_{12} = 0.6\ \Omega$.
Calculate :
1) Equivalent resistance, leakage reactance and impedance referred to HV side.
2) Equivalent resistance, leakage reactance and impedance referred to LU side.
3) Full load copper loss. **(15)**

(OR)

b) A 220 V, 22 A, 1000 rpm DC shunt motor has armature circuit resistance of 0.1Ω and field resistance of 100 Ω. Calculate the value of additional resistance to be inserted in the armature circuit in order to reduce the speed to 800 rpm. Assume the load torque to be (i) proportional to the speed and (ii) proportional to square of the speed. **(15)**

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