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Question Paper Code : 20454

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Fourth Semester

Electrical and Electronics Engineering

EE 6401 – ELECTRICAL MACHINES — I

(Regulations 2013)

(Common to PTEE 6401 — Electrical Machines – I for B.E. (Part-Time) – Third Semester – Electrical and Electronics Engineering – Regulations 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write the relationship between magneto motive force and magnetic field intensity.
2. Why magnetic core of a transformer is producing noise in audible bandwidth?
3. What is the use of Buchholz relay?
4. Mention the conditions for the successful operation of transformers which are connected to be in parallel.
5. Co-energy for a system is obtained as $(0.09/g)*(2/3)*i^{3/2}$. Find the force. Variables 'g' and 'i' can be considered as distance and current.
6. Write the energy balance equation for the block diagram shown in figure. 6

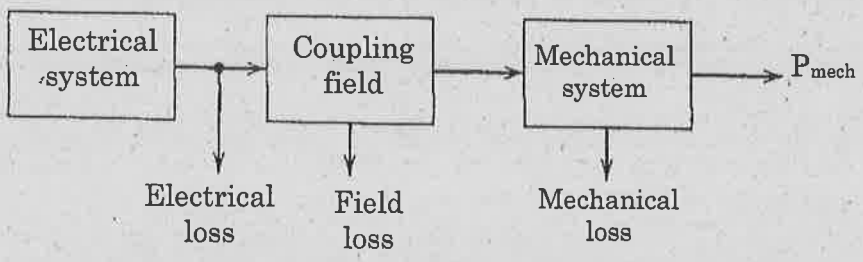

Figure 6. Electromechanical energy conversion system

7. Why torque production in DC machine is maximum?
8. What is the relationship between angular measure in space and angular measure in cycles?
9. Why series motor should be started with loaded condition?
10. What is the need of starter for DC motor?

PART B — (5 × 13 = 65 marks)

11. (a) The magnetic circuit of Figure 11 (a). has dimensions: $A_c = 4 \times 4$ cm^2, $l_g = 0.06$ cm, $l_c = 40$cm; N = 600 turns, Assume the value of $\mu_r = 6000$ for iron. Find the exciting current for $B_c = 1.2$ T and the corresponding flux and flux linkages. (5 + 8)

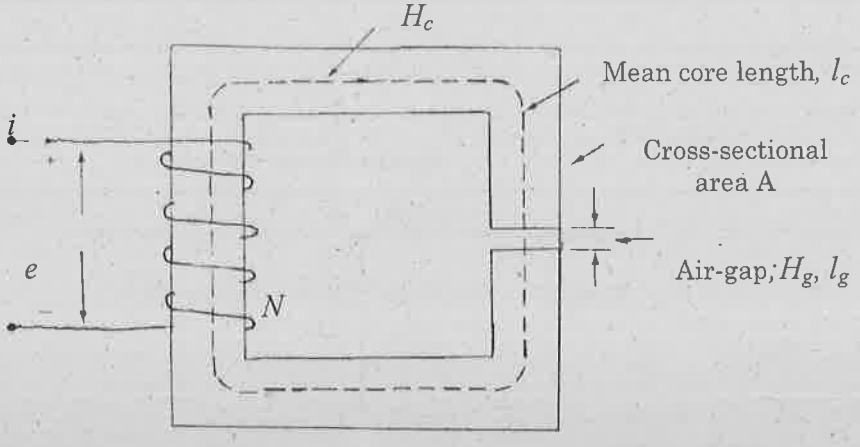

Figure 11 (a). Magnetic circuit

Or

(b) A square-wave voltage of amplitude E = 100 V and frequency 60 Hz is applied on a coil wound on a closed iron core. The coil has 500 turns, and the cross-sectional area of the core is 0.001 m^2, Assume that the coil has no resistance.

(i) Find the maximum value of the flux and sketch the waveforms of voltage and flux as a function of time. (6)

(ii) Find the maximum value of E if the maximum flux density is not to exceed 1.2 tesla. (7)

12. (a) A transformer on no-load has a core-loss of 50 W, draws a current of 2 A (rms) and has an induced emf of 230 V (rms). Determine the no-load power factor, core-loss current and magnetizing current. Also calculate the no-load circuit parameters of the transformer. Neglect winding resistance and leakage flux. (4 + 2 + 2 + 5)

Or

(b) A 50 kVA, 2400 = 240 V transformer has a core loss P_c =200 W at rated voltage and a copper loss P_{cu} = 500 W at full load. It has the following load cycle:

% Load	0.0%	50%	75%	100%	110%
Power factor		1	0.8 lag	0.9 lag	1
Hours	6	6	6	3	3

Determine the all-day efficiency of the transformer.

13. (a) Two coupled coils have self-and mutual-inductance and the values are given as follows:

$L_{11} = 2 + (1/2x)$; $L_{22} = 1 + (1/2x)$; $L_{12} = L_{21} = 1/2x$ over a certain range of linear displacement 'x'. The first coil is excited by a constant current of 20 A and the second by a constant current of –10A. Find :

(i) Mechanical work done if 'x' changes from 0.5 to 1 m. (6)

(ii) Energy supplied by each electrical source in part (i). (7)

Or

(b) Prove that a rotating magnetic field is produced when three phase supply is supplied to a three phase winding.

14. (a) Derive the emf equation of DC generator. Compare lap and wave winding. (9 + 4)

Or

(b) A 220 V DC generator supplies 4 kW at a terminal voltage of 220 V, the armature resistance being 0.4 Ω. If the machine is now operated as a motor at the same terminal voltage with the same armature current, calculate the ratio of generator speed to motor speed. Assume that the flux/pole is made to increase by 10% as the operation is changed over from generator to motor.

15. (a) A variable-speed drive system uses a DC motor that is supplied from a variable-voltage source. The torque and power profiles are shown in Figure 15 (a). The drive speed is varied from 0 to 1500 rpm (base speed) by varying the terminal voltage from 0 to 500 V with the field current maintained constant.

(i) Determine the motor armature current if the torque is held constant at 300 Nm up to the base speed. (6)

(ii) The speed beyond the base speed is obtained by field weakening while the armature voltage is held constant at 500 V. Determine the torque available at a speed of 3000 rpm if the armature current is held constant at the value obtained in part (i). Neglect all losses. (7)

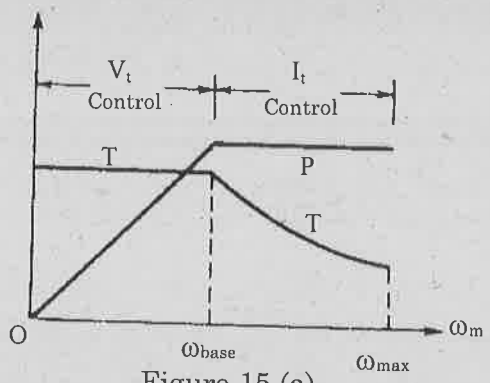

Figure 15 (a)

Or

(b) Explain the various characteristics of DC shunt motor with necessary graphs.

PART C — (1 × 15 = 15 marks)

16. (a) A DC shunt generator driven by a belt from an engine runs at 750 rpm while feeding 100 Kw of electric power into 230 V mains. When the belt breaks it continues to run as a motor drawing 9 kW from the mains. At what speed would it run? Given armature resistance 0.08 Ω and field resistance 115 Ω.

Note: In a shunt machine the field is connected across the armature and is also connected directly to the 230 V mains. The field excitation therefore remains constant as the machine operation changes as described above.

Or

(b) A 1φ, 100 kVA, 2000 = 200 V two-winding transformer is connected as an autotransformer as shown in Figure 16 (b) such that more than 2000 V is obtained at the secondary. The portion 'ab' is the 200 V winding, and the portion 'bc' is the 2000 V winding. Compute the kVA rating as an autotransformer.

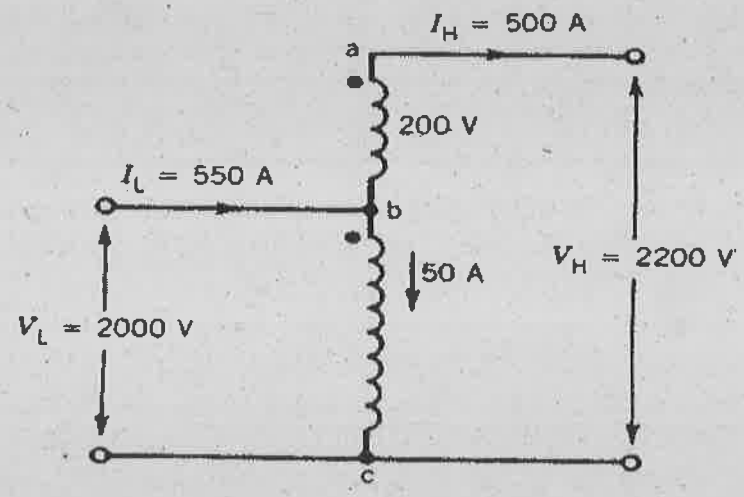

Figure 16 (b) Autotransformer