

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 0.08Ω and field resistance 115Ω .

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.

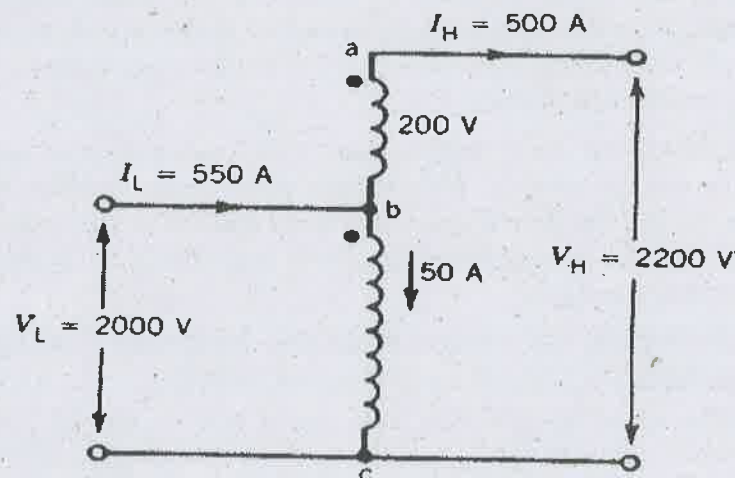


Figure 16 (b) Autotransformer

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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)

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

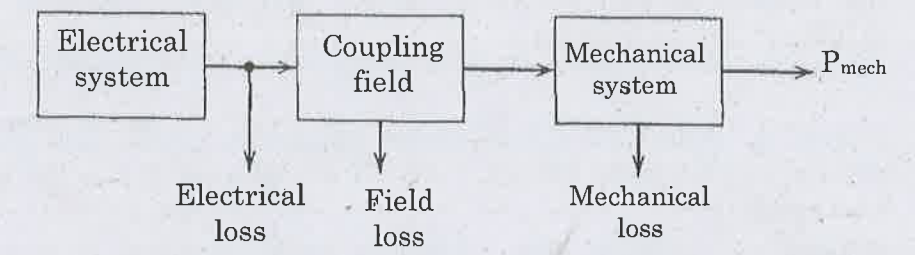


Figure 6. Electromechanical energy conversion system

- Why torque production in DC machine is maximum?
- What is the relationship between angular measure in space and angular measure in cycles?
- Why series motor should be started with loaded condition?
- 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: $A_c = 4 \times 4 \text{ cm}^2$, $l_g = 0.06 \text{ cm}$, $l_c = 40 \text{ cm}$; $N = 600$ turns, Assume the value of $\mu_r = 6000$ for iron. Find the exciting current for $B_c = 1.2 \text{ T}$ and the corresponding flux and flux linkages. (5 + 8)

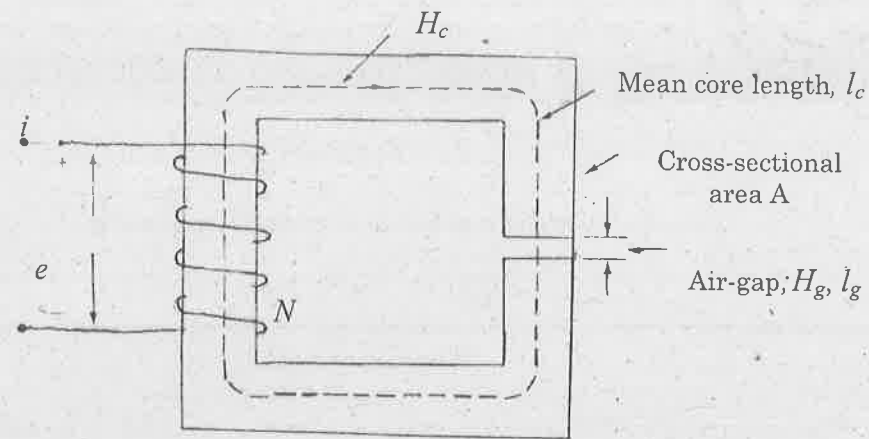


Figure 11 (a). Magnetic circuit

Or

- (b) A square-wave voltage of amplitude $E = 100 \text{ V}$ 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.
- Find the maximum value of the flux and sketch the waveforms of voltage and flux as a function of time. (6)
 - 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 , $2400 = 240 \text{ V}$ transformer has a core loss $P_c = 200 \text{ W}$ at rated voltage and a copper loss $P_{cu} = 500 \text{ W}$ 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 -10 A . Find :
- Mechanical work done if 'x' changes from 0.5 to 1 m . (6)
 - 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 0.4Ω . 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.
- Determine the motor armature current if the torque is held constant at 300 Nm up to the base speed. (6)
 - 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)

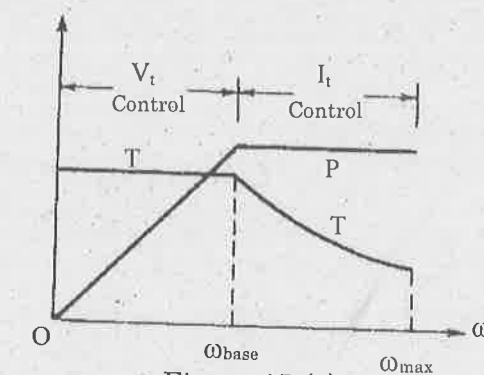


Figure 15 (a)

Or

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