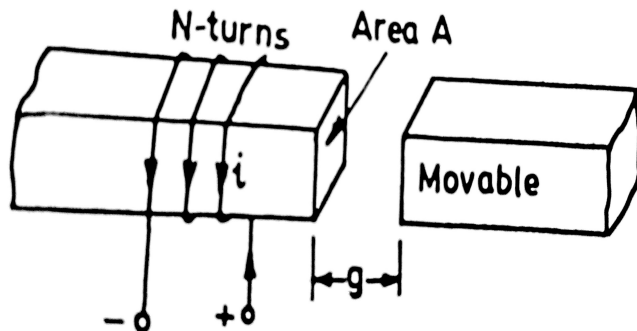


- (vii) Tertiary winding is used in transformer connected in
 (a) Delta/Delta (b) Delta/Star
 (c) Star/Star (d) Star/Zig-Zig.
- (viii) Absence of odd harmonics in magnetising current in a 3-phase core type transformer will make the voltage wave
 (a) sinusoidal (b) non-sinusoidal
 (c) asymmetrical (d) none of these.
- (ix) The utilization factor for transformers in open-delta is
 (a) 0.75 (b) 0.667 (c) 0.866 (d) 0.5.
- (x) Scott-connected transformers can convert
 (a) 3 to 2 phase (b) 2 to 3 phase
 (c) both (a) and (b) (d) 2 to 4 phase.

Group - B

2. (a) Show that e.m.f. generated in short-pitched coil is reduced by factor $\cos \frac{\alpha}{2}$ where α is the chording angle.
 (b) What are the advantages of fractional pitch winding?
 (c) What do you mean by phase-band and phase-spread? Explain why a phase-spread of 60° is preferred to a phase-spread of 120° in three-phase a.c machines.
3. (a) For the electromagnet shown in Fig1, obtain an expression for the magnetic force f_e . The reluctance is assumed to be offered by the airgap alone. Magnetic leakage and fringing is neglected.

**Fig.1**

- (b) For a 3-phase winding 3 slots per pole per phase and coil span of 8 slots, compute the breath and pitch factors. The flux density wave in the air gap of this machine is found to have 25% third harmonic. Calculate the percentage increase in per phase r.m.s. e.m.f. due to harmonic.

$$6 + 6 = 12$$

Group - C

4. (a) Two shunt generators operating in parallel have each an armature resistance of 0.03Ω . The combined external load current is 2000 A. If the generated emf of the machines are 560 V and 550 V respectively, calculate the bus-bar voltage and output in kW of each machine.
 (b) Explain the critical load resistance and critical field resistance of DC series and shunt generator.

$$7 + 5 = 12$$

5. (a) A 200V shunt motor has $R_a = 0.2 \Omega$, $R_f = 220 \Omega$ and the rotational loss 240W. Full load line current is 9A with the motor running at 1450 rpm. Determine (i) the mechanical power developed (ii) Power output (iii) Load torque (iv) full-load efficiency.
 (b) Draw the speed torque characteristics of DC shunt, series and compound motors in same diagram and compare them. Which of the characteristic is more suitable for traction purpose and why?

$$(4 \times 2) + (2 + 2) = 12$$

Group - D

6. (a) Calculate the percentage voltage drop for a transformer of 600kVA having a percentage resistance of 2.5% and a percentage reactance of 5% when it is delivering 400 kVA at 0.8 pf lagging.
 (b) The maximum efficiency of a 200 kVA, 2000/200 V, 50 Hz single-phase transformer is 98% and occurs at half load at unity pf. Determine its full-load efficiency at 0.8 lagging pf.
 (c) Why core loss is neglected in short-circuit test and copper loss in open-circuit test?

$$4 + 4 + 4 = 12$$

7. (a) The open-circuit and short-circuit tests on a 10 kVA, 500/250 V, 50 Hz, 1-phase transformer gave the following results:

Open-circuit: 250 V, 4A, 100 W (low voltage side)

Short-circuit: 25 V, 20 A, 90 W (high voltage side)

Determine the voltage regulation and maximum efficiency at 0.8 pf leading.

- (b) For the same voltage ratio and KVA-rating why is the efficiency of an auto transformer larger than a normal two-winding transformer?
- (c) Why tappings are provided in the hv windings of a transformer?

6 + 4 + 2 = 12

Group – E

8. (a) Draw the phasor diagram and connection diagram of the following three-phase transformer vector group.
(i) Dy1 (ii) Yz11
- (b) Explain the conditions that must be fulfilled for the successful parallel operation of 3-phase transformers.
- (c) Three single phase transformers, connected in Δ/Δ supply a balanced 3-phase load of 10 kW at 440 V, 0.8 p.f. leading. The transformers are supplied from 3-phase mains at 1100 V. Find the supply current.
9. (a) Why the Tertiary winding is used in three-phase transformer.
- (b) Draw the phasor diagram and connection diagram of double-delta connection.
- (c) How to suppress the harmonics of three-phase transformer?
- (d) Describe the merits and demerits of a bank of three single-phase transformers as compared to a 3-phase core type transformer.

3 + 2 + 3 + 4 = 12

ELECTRICAL MACHINE - I (ELEC 2201)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A (Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) The maximum speed at which the field of an alternator can be operated to develop 60 Hz is
(a) 2600 rpm (b) 1600 rpm
(c) 3600 rpm (d) 2800 rpm.
- (ii) The waveform of armature mmf in dc machine is
(a) square (b) rectangular
(c) triangular (d) sinusoidal.
- (iii) If a shunt generator delivers 100 A at 200 V and the resistance of the shunt field and armature are 100 Ω and 0.01 Ω , respectively, the generated emf will be
(a) 205 V (b) 212 V (c) 201.02 V (d) 208 V.
- (iv) The main advantage of using fractional pitch winding is to reduce
(a) harmonics in generated emf
(b) amount of copper in the winding
(c) size of the machine
(d) cost of the machine.
- (v) A pole pitch in electrical machines is
(a) = 180° electrical (b) = 180° mechanical
(c) > 180° electrical (d) < 180° electrical.
- (vi) The maximum efficiency of a transformer for constant load current, occurs at
(a) any p.f. (b) zero p.f. leading
(c) 0.8 p.f. lagging (d) unity p.f.