GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2022
ELECTRICAL MACHINES I
EE401

TIME ALLOTTED: 3 HOURS   FULL MARKS: 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable

GROUP – A
(Multiple Choice Type Questions)
Answer any *ten* from the following, choosing the correct alternative of each question: 10×1=10

		Marks	CO No.

1. (i) For carrying out parallel operation, transformers should have same X / R   —   1   CO1
ratio in order to avoid
   a) Leakage reactance.
   b) Insulation failure.
   c) Circulating current.
   d) Inrush current.

(ii) A 400V/100V, 10 kVA two-winding transformer is reconnected as an   —   1   CO2
auto-transformer across a suitable voltage source. The maximum rating of
such an arrangement could be
   a) 50 kVA
   b) 15 kVA
   c) 12.5 kVA
   d) 8.75 kVA

(iii) The armature reaction m.m.f. in a d.c. machine is   —   1   CO2
   a) Sinusoidal
   b) rectangular
   c) Trapezoidal
   d) Triangular

(iv) While carrying out Swinburne's test at rated armature voltage motor will   —   1   CO4
run at
   a) Speed equal to rated speed
   b) Speed greater than rated speed
   c) Can run anywhere
   d) Speed less than rated speed

(v) Maximum torque of a 3-phase induction motor is   —   1   CO3
   a) independent of rotor resistance r_2
   b) directly proportional to r_2
   c) inversely proportional to r_2
   d) proportional to r_2^2

(vi) A three phase induction motor should have small air gap length so that it has   1   CO3
- a) More starting torque
- b) More pull out torque
- c) Improved efficiency
- d) Better power factor

(vii) Blocked rotor test on a 3-phase induction motor helps to find out   1   CO2
- a) short circuit power factor
- b) fixed losses
- c) motor resistance referred to stator
- d) none of these

(viii) In which transformer, the tertiary winding is used?   1   CO2
- a) Star – delta
- b) Star – star
- c) Delta – delta
- d) Delta - star

(ix) The slip of an induction motor normally does not depend on   1   CO3
- a) Rotor speed
- b) Synchronous Speed
- c) Shaft Torque
- d) Core-loss Component

(x) Which is not mandatory for voltage build-up in dc generator   1   CO3
- a) Presence of Residual voltage
- b) Constant field current
- c) Field resistance is above critical resistance
- d) Speed is below critical speed

(xi) A 4-pole dynamo with wave wound armature has 51 slots containing 20 conductors in each slot. The induced emf is 357 V and the speed is 8500 rpm. The flux per pole will be   1   CO4
- a) 3.5 mWb
- b) 1.2 mWb
- c) 14 mWb
- d) 21 mWb

(xii) The direction of rotation of a DC shunt motor can be reversed by interchanging   1   CO2
- a) The supply terminals
- b) The field terminals only
- c) The armature terminals only
- d) Either armature or field terminals only

GROUP – B
(Short Answer Type Questions)
(Answer any *three* of the following)

		Marks	CO No.
		3 x 5 = 15	

2. A 10 kW, 400V, 3-phase, 4-pole, 50 Hz slipring induction motor develops rated output (i.e. 10kW) at rated voltage and frequency and with its sliprings short circuited. The maximum torque equal to twice the full load torque, occurs at a slip of 10% with zero external resistance and rotational losses are neglected.
   Determine , i) Slip and rotor speed at full load torque, ii) Rotor ohmic loss at full load torque and iii) Starting torque at rated voltage and frequency. — 5 — CO2

3. a) Sketch and explain the torque-slip and power-slip characteristics of the three phase induction motor — 2 — CO3

   b) Draw and explain the different characteristics of a DC shunt motor — 3 — CO3

4. a) How the rotation of induction motor can be reversed? — 1 — CO3

   b) Draw the connection diagram and corresponding phasor diagram for the following vector groups in three phase transformer
   i) Dd6   ii) Dy1 — 4 — CO4

5. What is armature reaction in a DC machine? How does it affect commutation? What steps are taken to have effective commutation? — 5 — CO3

6. a) Explain the phenomenon of cogging and crawling of a 3-phase induction motor — 1 — CO2

   b) Explain the voltage build-up process in D.C shunt generator. — 4 — CO3

GROUP – C
(Long Answer Type Questions)
(Answer any *three* of the following)

		Marks	CO No.
		3 x 15 = 45	

7. a) Draw the phaser diagram and connection diagram of the following three phase transformer groups : — 5 — CO2
   i) Dy1
   ii) Dz6
   iii) Yd11
   iv) Dd6

   b) A 6-pole, 148 A D.C shunt generator has 480 conductors and is wave wound. Its field current is 2 A. Find the demagnetizing and cross-magnetizing ampere turns per pole at full load if — 5 — CO3
   i. Brushes are on GNA
   ii. Brushes are shifted from GNA by 5° electrical
   iii. Brushes are shifted from GNA by 5° mechanical

   c) Explain the open delta connected transformer. — 5 — CO2

8. a) Why is a starter required in a 3-phase induction motor although it is self-starting? — 4 — CO3

   b) Show that a 3-phase distributed winding excited by balanced 3-phase currents will produce a sinusoidal distributed rotating field of constant amplitude when the phase windings are wound 120 electrical degrees apart in space. — 5 — CO2

   c) A D.C shunt machine connected to 250 volt D.C supply has an armature resistance of 0.12 Ω and the resistance of the field circuit is 100Ω. Calculate the ratio the speed as a generator to the speed as a motor. The line current in each case being 80 A. — 6 — CO2

9.a)	Explain the Swinburne's test to estimate no-load losses in a DC Machine.	4	CO2
b)	What do you mean by armature reaction in d.c. machine? Explain armature reaction considering fluxes due to field poles and armature m.m.f. with neat sketch.	4	CO2
c)	A 4 pole d.c. motor runs at 600 r.p.m. on full load taking 25 A at 450V. The armature is lap wound with 500 conductors and flux/pole is expressed by the relation $-\phi = 1.7 \times 10^{-2} \times I^{\frac{1}{2}}$, Wb, where I is the motor current. If the supply voltage and torque are both halved, calculate the speed at which the motor will run (ignore stray loss).	7	CO4
10.a)	Draw and explain the Torque-slip or Torque-speed curve of a three phase induction motor.	4	CO2
b)	Explain with the help of connection diagram how Scott-connections are used to obtain two phase supply from three phase mains.	5	CO2
c)	A 3-phase, four-pole, 50 Hz induction motor has a star connected rotor. The rotor has a resistance of 0.2 Ω per phase and standstill reactance of 2.4Ω per phase. The induced EMF between slip rings at standstill is 120 V. If the full load speed is 1440 rpm, calculate at full load (i) the slip (ii) the EMF induced in rotor per phase (iii) the rotor reactance per phase (iv) the rotor current (v) rotor power factor (vi) torque. Assume the slip rings are to be short circuited.	6	CO3
11.a)	What will happen if the primary of a transformer is connected to d.c supply?	2	CO3
b)	A 100 kVA distribution transformer supplying light and fan loads has full load copper-loss and core-loss of 1.5 and 2 kW respectively. During 24 h in a day the transformer is loaded as follows: 6 AM to 10AM (4h) Half-load 10 AM to 6 PM (8h) One-fourth load 6 PM to 10 PM (4h) Full-load 10 PM to 6 AM (8h) Negligible load Calculate the all-day efficiency of the transformer.	7	CO4
c)	Four point starter for d.c. motor.	6	CO3