GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2021
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)	DC series motor never switched on without load connected at rated voltage source because: a) The field current initially zero. b) The motor does not accelerate. c) The speed becomes dangerously high. d) None of these.	1	CO3
	(ii)	The rotor power output of 3-phase induction motor is 15kW. The rotor copper losses at a slip of 4% will be a) 600W b) 625W c) 650W d) 700W	1	CO2
	(iii)	How is the speed of a DC motor related to its back EMF and flux? a) Directly proportional to flux and inversely proportional to back EMF b) Inversely proportional to back EMF and inversely proportional to flux c) Directly proportional to back EMF and inversely proportional to flux d) None of these.	1	CO4
	(iv)	As compared to closed Δ, the capacity of the V-V connection of transformer is _____ percent. a) 57.7 %. b) 66.7 %. c) 50.0 %. d) 86.6 %.	1	CO2
	(v)	A 400V/100V, 10 kVA two-winding transformer is reconnected as an 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	1	CO2

(vi)	A three phase induction motor should have small air gap length so that it has a) More starting torque b) More pull out torque c) Improved efficiency d) Better power factor	1	CO3
(vii)	In dc shunt machine armature and field winding have a) Thin lead and thick lead respectively. b) Thick lead and thin lead respectively. c) Both windings have thin lead. d) Both windings have thick lead.	1	CO1
(viii)	In which transformer, the tertiary winding is used? a) Star – delta b) Star – star c) Delta – delta d) Delta - star	1	CO2
(ix)	The slip of an induction motor normally does not depend on a) Rotor speed b) Synchronous Speed c) Shaft Torque d) Core-loss Component	1	CO3
(x)	Any induction motor is analogous from equivalent circuit point of view, to a) DC motor. b) Transformer. c) Synchronous motor. d) DC generator.	1	CO3
(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 a) 3.5 mWb b) 1.2 mWb c) 14 mWb d) 21 mWb	1	CO4
(xii)	The direction of rotation of a DC shunt motor can be reversed by interchanging a) The supply terminals b) The field terminals only c) The armature terminals only d) Either armature or field terminals only.	1	CO2

GROUP – B
(Short Answer Type Questions)

(Answer any *three* of the following) **3 x 5 = 15**

		Marks	**CO No.**
2.	What is armature reaction in a DC machine? How does it affect commutation? What steps are taken to have effective commutation?	5	CO3
3. a)	Why does transformer core require to be laminated?	2	CO1

b)	A 400 kVA transformer has an iron-loss of 2 kW and the maximum efficiency at 0.8 power factor occurs when the load is 240 kW. Calculate the maximum efficiency on full-load at 0.71 power-factor lagging.	3	CO4
4.	Resistive loads of 5 Ω and 10 Ω are connected respectively across the teaser and main transformer secondary of a Scott-connected arrangement of transformers, fed from 3-phase 230 V supply main. If main transformer primary to secondary turns ratio is 2, then determine the supply line currents. The magnetizing currents and internal impedance drops are neglected	5	CO1
5.	The shaft output power of a three phase, 50 Hz induction motor is 30 KW at 1440 r.p.m. Total stator copper losses are 750 Watt and stator core losses are 830 Watt. Friction and windage losses amount of 1.2% of shaft output power. Determine stator and rotor input.	5	CO1
6.a)	What would happen if a power transformer designed for operation on 50 Hz were connected to a 5 Hz source of the same voltage?	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) **3 x 15 = 45**

		Marks	CO No.
7. a)	Explain the Swinburne's test to estimate no-load losses in a DC Machine.	4	CO2
b)	Derive the condition for maximum efficiency in a DC machine.	4	CO2
c)	Three single phase transformers connected in Δ/Δ supply a balanced three phase load of 1500 KW at 4400 V at 0.8 power factor lagging. The transformers are supplied from three phase mains at 11 KV. Find the current in the windings of each transformer. If one of the transformers is found faulty and is removed and the supply is maintained in open delta connection, determine the currents in the windings and the power supplied by each of the transformer.	7	CO4
8.a)	Explain with neat circuit diagram, the Ward-Leonard method of speed control of d.c series motor. What are the advantages and disadvantages?	5	CO2
b)	A 4 pole, 1200 rpm d.c. generator has 240 lap connected coils. Each coil has two turns. Each turn has 0.04 Ω resistance. Flux density is 0.6 T (uniform) under pole shoes and zero otherwise. Each pole shoe spans for 60° mechanical. The armature has a length = 50 cm and diameter = 40 cm. a. Estimate the generated e.m.f. (in V) at no load. Estimate the terminal voltage (in V) at full load current of 40A.	5	CO2
c)	Define de-magnetizing and cross-magnetizing ampere-turns	5	CO3

9.a)	Explain the phenomena of cogging and crawling of a three phase squirrel cage induction motor.	4	CO3
b)	Show that slip at which maximum torque of a three phase induction motor occurs is directly proportional to the rotor resistance $r_2$but the maximum torque T_m is independent of r_2.	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
10.a)	Draw the equivalent circuit of 3-phase induction motor and phasor diagram when it is operating on load	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)	State and explain the various conditions of parallel operation of three-phase transformer.	6	CO3