B.E. ELECTRICAL ENGINEERING EXAMINATION, 2024

(2nd Year, 1st Semester)

ELECTRICAL MACHINES – I

Time : Three Hours | Full Marks : 100

(50 marks for each part)

Use a separate Answer Script for each part.

Question No.	PART - I	Marks
	Answer question no. 1 and any two from the rest.	
1.	Justify the following (any six):	**6x3**
i)	Swinburne test cannot estimate the full load efficiency of a DC machine	
ii)	4-point starter has an overload protection.	
iii)	It is dangerous to run a DC series generator at no load.	
iv)	Due to wrong polarity connections voltage build-up in a DC shunt generator may fail.	
v)	Armature current and armature m.m.f – both are time-varying waveforms.	
vi)	Interpole plays dual role in a DC machine	
vii)	Hopkinson's test also called regenerative test.	
viii)	Ward-Leonard method of speed control is suitable for both constant torque and constant power drive.	
2. i)	Show that armature reaction in a DC machine has both cross-magnetizing and demagnetizing effect.	**4+4+8**
ii)	Discuss the magnetic core related modifications are usually opted for reducing adverse effects of armature reaction.	

Question No.		Marks
iii)	Estimate the reduction in speed of generator working with constant excitation of 250V bus bars to decrease its load from 250 kW to 125 kW. The resistance between terminals is 0.01 Ω. Neglect armature reaction.	
3. i)	Explain the process of commutation in a DC machine with proper diagrams.	5+3+8
ii)	Discuss the role of transformer e.m.f and rotational e.m.f in making the shape of transient current during commutation.	
iii)	A DC shunt machine connected to 220V mains has an armature resistance (including brushes) of 0.15 Ω and the resistance of the field circuit is 110 Ω. Find the ratio of the speed as motor to the speed as a generator, the line current in each case being 80A.	
4. i)	What is dummy coil?	2+3+4+7
ii)	What is equalizing ring? Why it is used?	
iii)	Define the terms: back pitch, coil span, front pitch, commutator pitch	
iv)	A 4 pole, 64 slot simplex lap wound DC armature has 1152 conductors. The no. of commutator segment is 192. Determine the number of coil side per slot, number of turns per coil and winding pitch. Draw the winding table. If the armature rotates at a speed of 1150 r.p.m. in a maximum field flux of 20mWb determine the induced voltage in the armature terminals.	
5. (i)	Discuss in detail any two techniques used for controlling speed of DC shunt motor.	8 + 8
ii)	A 220V shunt motor has an armature resistance of 0.5 and takes a current of 40A on full load. By how much must the main flux be reduced to raise the speed by 30%, if the developed torque remains constant.	

PART – II

6. Answer any one from (a) and (b): 10

a) Define no load current of a single phase transformer. Why no-load current of a transformer depends on supply voltage and frequency?

b) Why main flux of a transformer remains constant from no load to full load but leakage flux varies proportionately with load?

7. Answer any one from (a) and (b): 10

a) From the basic equations develop the equivalent circuit of a single phase transformer. State all the assumptions clearly.

(b) How the transformer equivalent circuit parameters are determined in the laboratory.

8. Answer any one from (a) and (b): 10

(a) Derive an expression for voltage regulation of a transformer.

(b) Derive an expression for saving in conductor material in an auto-transformer over a two-winding transformer of equal rating. State the advantages and disadvantages of auto-transformer over two-winding transformer.

9. Answer any one from (a) and (b): 10

(a) The maximum efficiency of a 500 kVA, 33000/500 Volt, 50 Hz, single-phase transformer is 0.97 pu and occurs at 75% full-load and unity power factor. If the leakage impedance is 10%, calculate the voltage regulation at full load, power factor 0.8 lagging.

(b) A 500 kVA, 33/3.3 kV single-phase transformer with a resistive voltage drop of 1.5% and a reactive voltage drop 6% is connected in parallel with a 1000 kVA, 33/3.3 kV single phase transformer with a resistive voltage drop of 1% and a reactive voltage drop of 6.2%. Find the kVA loading and operating power factor of each transformer when the load is 1200 kVA at power factor of 0.8 lagging.

10. Write short notes on (any four): 10

(a) Conservator & breather

(b) Transformer oil

(c) Buchholz Relay

(d) Explosion vent

(e) CRGOS