B.E. ELECTRICAL ENGINEERING SUPPLEMENTARY 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. 6 and any two from the rest.	
1.	Justify the following (any six) :	**6x3**
i)	Lap connected DC machine requires the equalizer connections whereas wave connected DC machine doesn't require it.	
ii)	Due to the armature reaction magnetic neutral is shifted in the direction of rotation in a DC motor.	
iii)	O.C.C or no-load characteristics cannot be obtained for series connected DC generator.	
iv)	For high-current and low-voltage DC machine lap connection is preferred whereas for low-current high-voltage DC machine wave connection is preferred.	
v)	DC series motor should not be operated under no-load.	
vi)	In Ward-Leonard method of DC machine speed control, both below and above the rated speed can achieved easily.	
vii)	In real-life we do not get exactly linear commutation.	
viii)	In a DC machine short-pitched coil is not preferred.	
2. **i)**	What are the conditions to be fulfilled to build up voltage in a shunt connected DC generator?	**6+2+8**
ii)	Why interpole winding is connected in series with the armature winding in a DC machine?	

Question No.		Marks
iii)	A 100 kW belt-driven shunt generator running at 300 rpm and 220V bus-bars continues to run as a motor when the belt breaks, then taking 10kW. What will be its speed? Armature resistance, r_a = 0.025 Ω.; field resistance, r_f = 60 Ω. Contact drop under each brush is 1V. Ignore armature reaction	
3. i)	Derive the expression of torque in a DC machine.	5+3+8
ii)	Why DC series motor is suitable for traction applications?	
iii)	A 220V DC shunt motor takes 22A at rated voltage and runs at 1000 rpm. It's field resistance is 100 Ω and armature resistance is 0.1 Ω. Compute the value of the additional resistance required to connected in the armature circuit to reduce the speed by 200 rpm in case of a fan load where the load torque is proportional to the square of the speed.	
4. i)	What are the remedies to get rid of the adverse effects of the armature reaction in a DC machine?	8 + 8
ii)	A DC shunt machine connected to 250V mains has an armature resistance (including brushes) of 0.12 Ω and the resistance of the field circuit is 100 Ω. Find the ratio of the speed as generator to the speed as a motor, the line current in each case being 80A.	
5.	Write short notes on any two of the following :	8x2
i)	Hopkinson's method of testing of DC machine	
ii)	Speed control of DC series motor	
iii)	External characteristics of different types of DC generators	

Ex/EE/PC/B/T/215/2024(S)

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PART – II

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

(a) Draw and explain the phasor diagram of a single phase transformer under (i) noload condition and (i) when supplying full load current at lagging p.f.

(b) From the basic principal develop equivalent circuit of a single phase transformer.

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

(a) Derive an expression for maximum efficiency of a transformer.

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

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

(a) Explain the working principle of Capacitor split phase motor. For Capacitor Split Phase Motor find the value of total Capacitance required for the starting winding to get the maximum starting torque.

(b) Develop an expression for the resultant torque of a single phase induction motor when running with slip s. Explain how the core losses are accounted for in determining the shaft power output.

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

(a) State and explain the conditions of parallel operation of single phase transformers.

(b) What are the advantage and disadvantage of an auto transformer?

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

(a) A 10 kVA, single phase transformer has a core loss of 70W and full load copper loss of 200W. The daily variation of the load on the transformer is as follows:

7 A.M. to 1 P.M. : 6 kW at 0.7 pf
1 P.M. to 6 P.M. : 4 kW at 0.85 pf
6 P.M. to 1 A.M. : 10 kW at 0.9 pf
1 A.M. to 7 A.M. : no-load

Determine the all-day efficiency of the transformer.

(b) A 5 kVA ,230 V/ 115V, 50 Hz, single phase transformer gave the following test results:
Open circuit test : 115 V, 1.2 A, 50 W
Short circuit test : 10.2 V, 21A, 80 W
Find the equivalent circuit parameters referred to HV side and calculate voltage regulation of the transformer at full load, 0.8 pf (lagging).