PAPER ID-421624

Subject Code: KEE402

Roll No: | | | | | | | | | | | | | |

BTECH
(SEM IV) THEORY EXAMINATION 2021-22
ELECTRICAL MACHINES-I

Time: 3 Hours ***Total Marks: 100***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

Q.No	Question	CO
a.	From consideration of the various energies involved, draw the model of an electromechanical energy conversion device.	1
b.	Why do all practical energy conversion devices make use of magnetic field as a coupling medium rather than an electric field? Also, Write the energy balance equation.	1
c.	Discuss briefly why dc machine is not started without a starter?	2
d.	Define back pitch and front pitch of armature winding in dc machine	2
e.	What are the factors that affect the speed of the dc motor?	3
f.	Which dc motor is used to drive cranes? Give reason.	3
g.	Why is transformer not used on dc supply?	4
h.	The emf per turn of a single-phase transformer 6.6 kV/440 V, 50 Hz transformer is approximately 12 V. Calculate the number of turns in the HV and LV windings.	4
i.	What are vector groups in 3-phase transformer?	5
j.	Compare core type and shell type 3-phase transformers.	5

SECTION B

2. Attempt any *three* of the following: 10x3=30

Q No.	Question	CO
a.	Show that the magnetic force f_e is given by the expression. $$f_e = -\frac{\partial W_{fld}}{\partial x}(\Psi, x) = -\frac{\partial W_{fld}}{\partial x}(\phi, x)$$	1
b.	Discuss armature reaction in dc machine. What is the (i) purpose and (ii) location of inter-poles and compensating winding in a dc machine? Explain with the help of neat sketches.	2
c.	Derive out the characteristics of (i) DC shunt motor (ii) DC Series Motor	3
d.	The following data were obtained for a 20-kVA, 60-Hz, 2400/240-V distribution transformer tested at 50 Hz: Voltage Current Power V A W OC test : 240 1.038 122 (on lv side) SC Test : 61.3 8.03 257 (on hv side) Compute the (i) efficiency at ¾ full-load current (ii) maximum efficiency and the load corresponding to max efficiency at unity power factor (iii) Secondary terminal voltage at 0.8 power factor when the applied input voltage is 2400 V and (iv) voltage regulation at 0.8 pf for lagging and leading load.	4
e.	With the help of circuit diagram describe open-delta connection? Prove that the open delta connection has a kVA rating of 57.7% of the rating of the normal delta-delta connection.	5

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SECTION C

3. Attempt any *one* part of the following: 10x1=10

Q No.	Question	CO
a.	Derive a relationship between magnetic field energy and co-energy for a singly excited system.	1
b.	For an electromagnetic system, show that the mechanical work done is equal to the area enclosed between the two magnetization curves at open and closed positions of the armature and the ψ-i locus during instantaneous armature movement.	1

4. Attempt any *one* part of the following: 10x1=10

Q No.	Question	CO
a.	With the help of neat sketch briefly (i) the process of commutation and (ii) delayed commutation in a dc machine.	2
b.	Derive the EMF equation and Torque equation of dc machine	2

5. Attempt any *one* part of the following: 10x1=10

Q No.	Question	CO
a.	With the help of suitable circuit diagrams, explain Armature Control Method and Field Control Method for speed control of DC Series Motor.	3
b.	Hopkinson's test conducted on 2 identical machines gave the following test result: field currents 5 A and 4.2 A, line voltage 230V, motor armature current 380 A, line currents excluding both the field currents is 50 A. Calculate the efficiency of both machines. Take R_a (each machine) =0.02 ohms.	3

6. Attempt any *one* part of the following: 10x1=10

Q No.	Question	CO
a.	With the help of circuit diagram explain the procedures of open circuit tests and short circuit tests conducted on a single-phase transformer. How parameters of equivalent circuit can be determined from these tests?	4
b.	A 200 kVA transformer has an efficiency of 98% at full load. If the maximum efficiency occurs at three quarters of full load, calculate the efficiency at half load. Assume negligible magnetizing current and power factor of 0.8 at all loads	4

7. Attempt any *one* part of the following: 10x1=10

Q No.	Question	CO
a.	What are the advantages of a bank of three 1-phase transformers over a unit transformer? Discuss the different types of connections employed in 3-phase transformers?	5
b.	Enumerate the conditions necessary for two 3-phase transformers to be connected in parallel. Two single phase transformers, rated 1000 kVA and 500kVA respectively, are connected in parallel on both HV and LV sides. They have equal voltage ratings of 11kV/400 V and their per unit impedances are (0.02 + j 0.07) and (0.025 +j 0.0875) respectively. What is the largest value of the unity power factor load that can be delivered by the parallel combination at the rated voltage? How is the load shared between the two transformers?	5