BT MRE-III(R/S)-11-24-3439 Reg. No. | | | | | | | | |

C

B.Tech. Degree III Semester Regular/Supplementary Examination in Marine Engineering November 2024

19-208-0302 ELECTRICAL TECHNOLOGY

(2019 Scheme)

Time: 3 Hours Maximum Marks: 60

Course Outcome

On successful completion of the course, the students will be able to:

CO1: Understand the construction and working of transformers, transformer losses, current transformers and potential transformers.

CO2: Study the different types, constructional details, operational principles and performance characteristics of DC motors and DC generators.

CO3: Understand the constructional details, operational principles and performance characteristics of induction motors and alternators.

CO4: Learn about the constructional details, operational principles and performance characteristics of Alternators.

CO5: Understand the constructional details, operational principles and performance characteristics of synchronous machines.

Bloom's Taxonomy Levels (BL): L1 – Remember, L2 – Understand, L3 – Apply, L4 –Analyze, L5 – Evaluate, L6 – Create

PI – Programme Indicators

(Answer *ALL* questions) (5 × 15 = 75)

			Marks	BL	CO	PI
I.	(a)	Define transformation ratio. Derive the EMF equation of the Transformer.	5	L1	1	1
	(b)	The instrument readings obtained from open and short-circuit tests on 10 kVA, 450/120 V, 50 Hz transformer are: O.C. test: $V_1 = 120$ V; $I_1 = 4.2$ A; $W_1 = 80$ W; read on LV side S.C. test: $V_1 = 9.65$ V; $I_1 = 22.2$ A; $W_1 = 120$ W; read on HV side Compute: (i) the equivalent circuit constants (ii) efficiency and voltage regulation for an 80% lagging power factor load (iii) the efficiency at half full load and 80% lagging power factor load.	10	L5	1	2
		OR				
II.	(a)	The core of a three-phase, 50 Hz, 11000/550 V delta/star, 300 kVA, core-type transformer operates with a flux of 0.05 Wb. Find (i) number of H.V. and L.V. turns per phase. (ii) EMF per turn. (iii) full load H.V. and L.V. phase-currents.	8	L4	1	2
	(b)	With the necessary equations of 1° and 2° sides of the transformer, draw the phasor diagram, if the connected load is capacitive (Take K = 1).	7	L2	1	1

(P.T.O.)

			Marks	BL	CO	PI
III.	(a)	DC series motor should always start with some load on the shaft, explain the necessary equations of N and T with respect to I_a and Ø. Draw the following performance characteristics of the DC series motor (i) N vs I_a (ii) T vs I_a (iii) N vs T.	10	L2	2	1
	(b)	A shunt generator has an FL current of 196 A at 220 V. The stray losses are 720 W and the shunt field coil resistance is 55 Ω. If it has an F.L. efficiency of 88%, find the armature resistance. Also, find the load current corresponding to maximum efficiency.	5	L3	2	2
		OR				
IV.	(a)	A 4-pole, 240 V, wave-connected shunt motor gives 1119 kW when running at 1000 rpm and drawing armature and field currents of 50 A and 1.0 A respectively. It has 540 conductors. Its resistance is 0.1 Ω. Assuming a drop of 1 volt per brush, find (i) Total torque. (ii) Useful torque. (iii) Useful flux/pole. (iv) Rotational losses. (v) Efficiency.	10	L4	2	2
	(b)	Draw the magnetization characteristics of a DC shunt generator and explain the importance of residual flux in the power generation of a self-excited DC machine.	5	L2	2	1
V.		Single-phase induction motor is not self-starting, Why? Explain Double-field revolving theory.	15	L2	3	1
		OR				
VI.	(a)	With the necessary equations and phasor, explain the production of a revolving magnetic field with the applied 3 Ø supply.	7	L2	3	1
	(b)	A 4-pole, 3 Ø, induction motor operates from a supply whose frequency is 50 Hz. Calculate: (i) the speed at which the magnetic field of the stator is rotating. (ii) the speed of the rotor when the slip is 0.04. (iii) the frequency of the rotor currents when the slip is 0.03. (iv) the frequency of the rotor currents at standstill.	8	L4	3	2
VII.	(a)	Explain the constructional details of the Alternator.	8	L3	4	1
	(b)	The following test results are obtained from a 3-phase, 6,000-kVA, 6,600V, star-connected, 2-pole, 50-Hz alternator: With a field current of 125 A, the open-circuit voltage is 8,000 V at the rated speed; with the same field current and rated speed, the short-circuit current is 800 A. At the rated full load, the resistance drop is 3 percent. Find the regulation of the alternator on full load and at a power factor of 0.8 lagging.	7	L3	4	2
		OR				
VIII.	(a)	Derive the EMF equation of the Alternator.	7	L1	4	1
	(b)	Find the synchronous impedance and reactance of an alternator in which a given field current produces an armature current of 200 A on short-circuit and a generated e.m.f. of 50 V on open-circuit. The armature resistance is 0.1 Ω. To what induced voltage must the alternator be excited if it is to deliver a load of 100 A at a p.f. of 0.8 lagging, with a terminal voltage of 200 V.	8	L3	4	2

(Continued)

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			Marks	BL	CO	PI
IX.	(a)	Draw the circuit diagram and phasor diagram of the synchronous motor.	5	L2	5	1
	(b)	Derive the expression for gross mechanical power developed in synchronous motors.	5	L1	5	1
	(c)	Draw the block diagram showing different power stages in a synchronous motor.	5	L2	5	1
		OR				
X.	(a)	What are the characteristic features of synchronous motors?	5	L1	5	1
	(b)	Explain the principle of operation of the synchronous motor.	10	L2	5	1

Blooms's Taxonomy Level
L1 – 13.33%, L2 – 6.67%, L3 – 20%, L4 – 30%, L5 – 30%.

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