BT-MRE III-12.14-1151 Reg. No. | | | | | | | | |

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# *B. Tech Degree III Semester Examination in Marine Engineering December 2014*

## MRE 1302 ELECTRICAL TECHNOLOGY

Time: 3 Hours Maximum Marks: 100

(5 x 20 = 100)

I. (a) Explain the elementary theory of an ideal transformer with vector diagram and waveform. (10)

(b) A 3300/300 V, 300 kVA single-phase transformer has 1100 primary turns. Find: (i) Transformation ratio (ii) Number of secondary turns (iii) Voltage per turn (iv) Secondary current when it supplies a load of 200 kW at 0.8 power factor lagging. (10)

**OR**

II. (a) What is voltage regulation of a transformer? Explain how it can be predetermined for a transformer from tests. (8)

(b) The following reading were obtained from OC an SC tests on a 200/400 V, 50 Hz single-phase transformer. (12)

OC Test (on LV side) : 200V, 0.6A, 60W
SC Test (on HV side) : 15V, 9A, 80W.

(i) Obtain the approximate equivalent circuit referred to primary
(ii) Calculate the secondary voltage when delivering 4 kW at 0.8 pf lagging, the primary voltage being 200 V.

III. (a) What is Armature Reaction in DC machines? What are its effects? Explain the methods of minimizing the adverse effects of armature reaction. (10)

(b) The magnetisation curve of a dc shunt generator at 1500 rpm is: (10)

| $I_f$ (A) | 0 | 0.4 | 0.8 | 1.2 | 1.6 | 2.0 | 2.4 | 2.8 | 3.0 |
|---|---|---|---|---|---|---|---|---|---|
| $E_o$ (V) | 6 | 60 | 120 | 172.5 | 202.5 | 221 | 231 | 237 | 240 |

For this generator, find:
(i) No-load emf for a total shunt filed resistance of 100 Ω.
(ii) The critical field resistance at 1500 rpm.
(iii) The magnetization curve at 1200 rpm and therefrom the open circuit voltage for a field resistance of 100 Ω.

**OR**

IV. (a) Explain the different methods of speed control of a DC shunt motor. (10)

(b) A 4-pole. 250V, wave connected shunt motor gives 10 kW when running at 1000 rpm and drawing armature and field currents of 60 A and 1 A respectively. It has 560 conductors. Its armature resistance is 0.2 Ω. Assuming a drop of IV per brush, determine: (i) Total or gross torque (ii) Useful or shaft torque (iii) Useful flux per pole (iv) Rotational looses (v) Efficiency. (10)

**(P.T.O.)**

V. (a) Explain the principle and theory of operation of a three-phase induction motor. (12)

(b) A 3-phase, 6-pole, 50 Hz induction motor has a slip of 1% at no-load and 3% at full-load. Find: (i) Synchronous speed (ii) No-load speed (iii) Full-load speed (iv) Frequency of rotor current at standstill (v) Frequency of rotor current at full-load. (8)

**OR**

VI. (a) Draw and explain the torque-slip characteristics of a three-phase induction motor. (6)

(b) A 3-phase 3.677 kW, 200 V, 50 Hz, 4-pole, 3-phase star connected induction motor gave the following test results: (14)

No-load Test : 200 V, 5 A, 350 W

Blocked-Rotor Test : 100 V, 26 a, 1700 W.

Rotor copper loss at standstill is half the total copper loss.

Draw the circle diagram and find from the circle diagram:

(i) full-load values of current, power-factor, slip, speed, torque and efficiency (ii) the values of maximum torque and maximum output power.

VII. (a) What is an alternator? What is the principle of operation of an alternator? Derive the EMF equation of an alternator. (10)

(b) Calculate the speed and open-circuit line and phase voltages of a 4-pole, 3-phase, 50 Hz star connected alternator with 36 slots and 30 conductors per slot. The flux per pole is 0.05 wb sinusoidally distributed. Assume full-pitched windings. (10)

**OR**

VIII. (a) Explain why synchronous motors are not self-starting. Describe the different methods of starting synchronous motors. (10)

(b) A 3-phase star connected alternator rated at 3.3 kV, has a full-load current of 100 A and armature resistance of 0.9 Ω per phase. A field current of 5 A is necessary to produce full-load current on short-circuit. The open-circuit voltage for the same excitation is 900V. Determine the full-load voltage regulation of the alternator at upf, 0.8 pf lead and 0.8 pf lag. (10)

IX. (a) Describe a typical AC power supply scheme with lay-out. (10)

(b) Compare AC and DC transmission systems. (10)

**OR**

X. (a) Explain radial, ring main and inter-connected distribution systems. (10)

(b) Write notes on: (10)

(i) Fuses and its materials

(ii) Circuit breakers

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