INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

B.TECH (MARINE ENGINEERING)

DEC 2014 / JAN 2015 END SEMESTER EXAMINATIONS

III SEMESTER

ELECTRICAL MACHINES – I (T2306/T1306)

Time : 03.00Hrs **Max Marks: 100**

Date : 05.01.2015 **Pass Marks: 50**

Part A ($3\times10=30$ **Marks)**

Compulsory Questions

1) (a) What are the factors on which the emf of a DC generator depends? (3)

(b) What do you mean by back torque of a DC generator and what are its effects? (3)

(c) What are the conditions for building up of self-excited shunt generator? (3)

(d) What are the losses in a DC motor? (3)

(e) What is hysteresis loss? (3)

(f) Discuss the difference between AC distributor and DC distributor. (3)

(g) What are the functions of a starter? (3)

(h) A 6-pole, lap-wound armature has 840 conductors and flux per pole of 0.018 Wb. Calculate the emf generated, when the machine is running at 600 rpm. (3)

(i) Explain why core flux in a transformer is almost independent of load current? (3)

(j) Explain why leakage flux in a transformer is dependent on load current? (3)

Part B ($5\times14=70$ **Marks)**

Answer Any Five of the following

2) (a) Draw a neat sketch of a DC Machine. State the functions of major parts. (3 + 5)

(b) Derive the emf equation of a DC machine by using *Blv* concept. (6)

3) The open-circuit characteristic of a DC generator at 800 rpm is as follows:

Field current (A)	: 0.5	1.0	1.5	2.0	2.5	3.0	3.5
Generated emf (V)	: 48	96	110.40	116	119.20	120.80	121.60

The machine is connected as shunt generator and driven at 1000 rpm. The resistance of shunt field circuit being $60\,\Omega$. Calculate (i) open circuit voltage, (ii) the critical value of the field resistance, (iii) the terminal voltage when the load has resistance of $4\,\Omega$, and (iv) the load current when the terminal voltage is 100V. Neglect armature reaction. The armature resistance is $0.1\,\Omega$. (14)

4) (a) A long-shunt DC dynamo having terminal voltage of 250 V at 1000 rpm supplies 25 kW. The resistances of armature, shunt field and series field are 0.04 Ω, 50 Ω and 0.05 Ω respectively. Calculate (i) Cu-losses, (ii) iron and friction losses and (iii) the torque exerted by the prime mover if it has efficiency 89% of the above load. (7)

(b) A 10 kW, 240 V, DC shunt motor draws a line current of 5.2 A while running at no-load speed of 1200 rpm from a 240 V DC supply. It has an armature resistance of 0.25 Ω and field resistance of 160 Ω . Determine the efficiency of the motor when it delivers the rated load. (7)

5) (a) Draw a labeled diagram and describe the working of a three-point starter for a DC shunt motor. (7)

(b) A 2-wire DC ring distributor is 300 m long and is fed at 240 V at point A. At point B, 150 m from A, a load of 120 amps is taken and at C, 100 m in the opposite direction, a load of 80 amps is taken. If the resistance per 100 m of single conductor is 0.03 Ω, find the current in each section of distributor. (7)

6) A 240 V DC shunt motor takes 26 A at rated voltage and runs at 1000 rpm. Its field resistance is 120 Ω and armature circuit resistance (including brushes) is 0.25 Ω . Compute the value of additional resistance required in the armature circuit to reduce the speed to 900 rpm, when (i) the load torque is independent of speed, (ii) the load torque is proportional to speed and (iii) the load torque varies as square of the speed. (14)

7) (a) Derive an expression for the e.m.f induced in a transformer windings. (6)

(b) A 1000-VA 230/115-V transformer has been tested to determine its equivalent circuit. The results of the tests are shown below.

Open-circuit test: $V_{OC} = 230$ V, $I_{OC} = 0.45$ A, $P_{OC} = 30$ W
Short-circuit test: $V_{SC} = 19.1$ V, $I_{SC} = 8.7$ A, $P_{SC} = 42.3$ W

All data given were taken from the primary side of the transformer.
i) Find the equivalent circuit of this transformer referred to the low-voltage side of the transformer.
ii) Determine the transformer's efficiency at rated conditions at 0.8 P.f lagging. (8)

8) (a) Explain how the primary current increases as the current on the secondary side of the transformer is increased. (7)

(b) Develop the phasor diagram under leading p.f load for a single-phase transformer. (7)

9) (a) Describe the conditions for paralleling of single-phase transformers. (6)

(b) A 15-kVA ,8000-V/230-V transformer has an impedance referred to the primary of (80+j300) Ω . The components of the excitation branch referred to the primary side are $R_C = 350$ kΩ and X_M=70kΩ. If the primary voltage input is 7967 V and the load impedance across secondary is $Z_L = (3.2 + j1.5)\ \Omega$,

(i) What is the secondary voltage across load of the transformer?
(j) What is the voltage regulation of the transformer? (8)

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