B.Tech. Degree III Semester Supplementary Examination in Marine Engineering December 2018

MRE 302 ELECTRICAL TECHNOLOGY
(Prior to 2013 Scheme)

Time: 3 Hours   Maximum Marks: 100

$(5 \times 20 = 100)$

I.   (a) State and prove the condition for maximum efficiency of a transformer.   (8)

     (b) A single phase transformer is rated at 10 kVA, 230/100 V. When the   (12)
          secondary terminals are open circuited and the primary winding is supplied
          at normal voltage (230 V), the current input is 2.6 A at a power factor of 0.3.
          When the secondary is short circuited, a voltage of 18 V applied to the
          primary causes the full load current (100 A) to flow in the secondary, the
          power input to the primary being 240 W. Draw the equivalent circuit
          referred to LV side. Calculate (i) the efficiency of the transformer at full
          load, unity power factor (ii) the load at which maximum efficiency occur
          (iii) the value of the maximum efficiency.

OR

II. (a) Derive an expression for saving of copper in an autotransformer as compared   (6)
          to an equivalent two winding transformer.

     (b) Draw and explain the vector diagram of practical transformer when it is   (4)
          connected to a capacitive load.

     (c) A 50 kVA, 2200/110 V, 50 Hz, 1 Φ transformer gave the following results: (10)

          O.C. test: 400 W, 10 A, 110 V

          S.C. test: 808 W, 20.5 A, 90 V

          Draw the equivalent circuit referred to HV side.

III. (a) DC shunt motor is considered as a constant speed motor. Why?   (8)

     (b) A shunt motor takes an armature current of 50 A at 250 V when running on   (12)
          full load at a speed of 800 rpm. The armature resistance is 0.2 Ω. If the field
          strength is reduced by 10% and the torque remains the same, determine the
          steady speed attained and the armature current.

OR

IV. (a) A 4 pole, 460 V shunt motor has its armature wave wound with 888   (8)
          conductors. The useful flux per pole is 0.02 wb and the resistance of the
          armature circuit is 0.7 Ω. If the armature current is 40 A, calculate
          (i) the speed (ii) the torque in Nm.

     (b) Explain Armature reaction in DC machine.   (8)

     (c) Why does the field winding of a DC series machine has less number of turns   (4)
          than that of a DC shunt machine?

V. (a) The power input to a 500 V, 50 Hz, 6 pole, 3 Φ induction motor running at 975 rpm is 40 kW. The stator losses are 1 kW and the friction and windage losses total 2 kW. Calculate (i) slip (ii) the rotor copper loss (iii) shaft power (iv) the efficiency. (10)

(b) Explain any three speed control method of 3 Φ induction motor. (10)

OR

VI. (a) Explain Double field revolving theory. (8)

(b) A 400 V, 3 Φ delta connected induction motor gave the following results on no load and short circuit. (line values) (12)

No load test: 400 V, 3 A, 645 W

Short circuit test: 200 V, 12 A, 1660 W

The friction and windage losses amount to 183 W. Determine energy and magnetizing components of no load current, no load power factor, no load resistance R_0 and reactance X_0, Equivalent resistance and reactance per phase as referred to primary, power factor on short circuit and short circuit current with normal applied voltage of 400 V across the stator. Stator resistance may be assumed to be 5 Ω.

VII. (a) Define (i) pitch factor (ii) breadth factor. (10)

(b) A 3.3 kV, 3 Φ star connected alternator has a full load current of 100 A. Under short circuit it takes 5 A field current to produce full load short circuit current. The emf on open circuit for the same excitation is 900 V (line to line). The armature resistance is 0.9 Ω/phase. Determine synchronous reactance per phase and voltage regulation for (i) 0.8 p.f. lagging (ii) 0.8 p.f. leading. (10)

OR

VIII. (a) Explain the production of rotating magnetic field. (6)

(b) Explain the effect of excitation on armature current and power factor. (6)

(c) Explain the principle of operation and construction of 3 Φ synchronous motors. (8)

IX. (a) What are the advantages of 3 Φ transmission over 1 Φ power transmission. (7)

(b) Explain the operating principle of circuit breakers. (5)

(c) What is meant by ring main distributor? (8)

OR

X. (a) Explain two wire and three wire DC distribution with neat diagrams. (10)

(b) What is electric power supply system? Draw a single line diagram of a typical ac power supply scheme. (10)

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