D 20615-A (Pages : 3) Name.....

Reg. No.....

THIRD SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, OCTOBER 2011

AN/ME/AM 09 305—ELECTRICAL TECHNOLOGY

(2009 admissions)

Time : Three Hours Maximum : 70 Marks

Part A

Answer **all** *questions.*
Each question carries 2 *marks.*

1. Draw a three point starter and indicate its important components.
2. What is an autotransformer ? State its merits and demerits over two winding transformer.
3. What are all the advantages of induction motor over other motors ?
4. Why is the single-phase induction motor is not self starting ?
5. How is Chopper used in speed control of d.c. motor ?

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*
Each question carries 5 *marks.*

6. Describe the construction of armature field and commutator of a d.c. machine.
7. How will you determine power rating of electric motor for continuous duty and constant load ?
8. A 1 kVA single-phase transformer has an iron loss of 12 W and a full-load copper loss of 18 W. Find the full-load efficiency assuming the power factor to be 0.9.
9. A three-phase, 50 Hz, six-pole induction motor has a slip of 0.04 per unit when the output is 20 kW. The frictional loss is 250 W. Calculate (a) the rotor speed ; (b) the rotor I^2R loss.
10. Explain the loading of an electric motor and its duty cycle with sample diagram.
11. Explain the conditions to achieve electric regenerative breaking.

(4 × 5 = 20 marks)

Part C

Answer section (a) **or** *section (b) of each question.*
Each question carries 10 *marks.*

12. (a) (i) Explain the function of the commutator in a d.c. machine. (5 marks)

(ii) A six pole d.c. generator has a lap connected armature with 480 conductors. The resistance of the armature circuit is 0.02 Ω. With an output current of 500 A from the armature, the terminal voltage is 230 V when the machine is driven at 900 r.p.m. Calculate the useful flux per pole and derive the expression employed.

(5 marks)

Or

Turn over

(b) (i) Explain the necessity for using a starter with a d.c. motor. (5 marks)

(ii) A 240 V d.c. shunt motor has an armature of resistance of 0.2 Ω. Calculate (1) the value of resistance which must be introduced into the armature circuit to limit the starting current to 40 A. (2) the e.m.f. generated when the motor is running at a constant speed with this additional resistance in circuit and with an armature current of 30 A. (5 marks)

13. (a) Derive an expression for the deflecting torque of a moving iron instrument in terms of change of inductance of its coil with deflection θ.

The inductance L of a spring controlled moving iron ammeter is given by the following expression in which θ is the deflection in radians.

$L = 1.0 + 0.716\theta - 0.0114\,\theta^2$ mH. The control torque constant is 0.57×10^{-3} Nm/rad. Calculate (i) the current for full scale deflection of 120° ; (ii) current for one half full scale deflection ; and (iii) deflection for one-quarter of full scale current. (10 marks)

Or

(b) The following results were obtained on a 50 kVA transformer : Open circuit test - primary voltage, 3300 V ; Secondary voltage 400 V ; Primary power 430 W. Short circuit test - primary voltage 124 V primary current 15.3 A ; primary power 525 W ; secondary current, full-load value calculate :

(i) The efficiencies at full-load and at half load for 0.7 power factor.

(ii) The voltage regulations for power factor 0.7 (A) lagging ; (B) leading.

(iii) The secondary terminal voltages corresponding to (A) and (B). (10 marks)

14. (a) Two single-phase generators are connected in parallel and the excitation of each machine is such as to generate an open-circuit e.m.f. of 3500 V. The stator winding of each machine has a synchronous reactance of 30 Ω and negligible resistance. If there is a phase displacement of 40 electrical degrees between the e.m.f.s calculate (i) the current circulating between the two machines ; (ii) the terminal voltage ; (iii) the power supplied from one machine to the other. Assume that there is no external load. Sketch the phasor diagram. (10 marks)

Or

(b) Describe briefly the construction of the stator and slip ring rotor of a three-phase induction motor, explain the action of the motor and why the rotor is provided with slip rings.

A three-phase, 50 Hz induction motor has four poles and runs at a speed of 1440 r.p.m. when the total torque developed by the rotor is 70 Nm. Calculate (i) the total input to the rotor ; (ii) the rotor I^2R loss in watts. (10 marks)

15. (a) A thyristor is connected in series with a 100 Ω resistor to a 230 V sinusoidal supply. If the thyristor is controlled to switch on at a firing angle of 30° (i) determine the average current in the resistor ; (ii) determine the firing angle if the average current is 0.25 A ; (iii) the thyristor is upgraded to a fully controlled converter. Determine (A) the average resistor current when the firing angle is 25° ; (B) the firing angle when the average resistor current is 0.30 A.

(10 marks)

Or

(b) A simple three-phase rectifier network supplies a 50 Ω resistive load from a 400 V, 50 Hz, three-phase source. Determine (i) the mean load current ; (ii) the mean load voltage.

The rectifier network is replaced by a three-phase bridge rectifier again determine ; (i) the mean load current ; (ii) the mean load voltage.

(10 marks)

[4 × 10 = 40 marks]