

University of Technology-Electromechanical Engineering Department
Final Year Exam-First Attempt - (2013-2014)

Class: 4th Year

Branch: Electromechanical Systems / Energy

Subject: Power Electronics & Electrical Drives

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Time Allowed: 3 hrs

Date: / 5 / 2014

Note: Answer only 5-questions

Name:

ID No.

Signature:

Q1: (A) Choose the correct answers for the following questions:

- 1) Each diode of a three phase half wave diode rectifier conducts for:
(a) 60° (b) 90° (c) 180° (d) 120°
 - 2) A chopper has (V_s) as the voltage source, R as the load resistance, and (D) as the duty cycle. For this chopper, rms value of output voltage is:
(a) $D.V_s$ (b) $\sqrt{D}.V_s$ (c) V_s/\sqrt{D} (d) $\sqrt{1-D}.V_s$
 - 3) An IGBT has three terminals called:
(a) *Collector, emitter, and base* (b) *Collector, emitter, and gate*
(c) *Drain, source, and base* (d) *Drain, source, and gate*
 - 4) For a three phase bridge diode rectifier, the average output voltage in terms of maximum value of line voltage (V_m) is:
(a) $\frac{3V_m}{\pi}$ (b) $\frac{3\sqrt{2}.V_m}{\pi}$ (c) $\frac{3\sqrt{3}.V_m}{2\pi}$ (d) $\frac{3\sqrt{3}.V_m}{\pi}$
 - 5) During the forward blocking region, a thyristor is associated with:
(a) *Large current, low voltage* (b) *Low current, large voltage*
(c) *Medium current, large voltage* (d) *Low current, medium voltage*
 - 6) The shape of output characteristics in the forward direction of IGBT is similar to that of
(a) *Triac* (b) *diode* (c) *thyristor* (d) *BJT*
- (6 Marks)
- (B) State the applications of power electronics. (3 Marks)
- (C) Classify the power electronics converters. (3 Marks)

Q2: A heavily inductive DC load requires (10A) at (100V) from a (220V) single phase uncontrolled bridge rectifier. 1) Draw this circuit then trace V_{in} , V_L , I_L waveforms. 2) Give design details for the transformer and diode rating. Assume each diode have (1V) voltage drop. (12 Marks)

Q3: (A) A three phase bridge inverter each thyristor conducts for (120°) and R_{load} is Y-connected. 1) Draw the sequence of firing angles for various thyristor (I_g), conducting thyristors and the circuit. 2) Draw the waveforms (V_a, V_b, V_c , and V_{bc}). (6 Marks)

(B) A three phase bridge PWM inverter fed by three phase uncontrolled bridge rectifier through DC link consists of L-C filter used to supply three phase resistive load. Draw this circuit in details then draw the supply voltage. (6 Marks)

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Q4: (A) What is a dc **chopper**? Describe the various types of chopper depending upon the directions of current & voltage flows with appropriate circuit and operation diagrams. (6 Marks)

(B) A single phase bidirectional **regulator** is feeding resistive load of (**11Ω**). The supply voltage is (**220V, 50Hz**) if the firing angle is (**90°**). **Determine** the power absorbed by the load. (6 Marks)

Q5: (A) What is **regenerative braking**? Describe the regenerative braking of a **chopper-fed separately excited DC motor**, illustrate your answer with circuit diagram & draw the waveforms (**I_a , V_t , I_s , I_T**). (6 Marks)

(B) The **chopper** used for ON-OFF control of a **separately-excited DC motor** has supply voltage of (**220V DC**), an ON-time of (**11msec**) and OFF-time of (**14msec**). Neglecting armature inductance & assuming continuous conduction of motor current. **Determine** the average load current when the motor speed is (**1400 rpm**) and has voltage constant of (**$k_m = 0.5 \text{ V/rad/S}$**). The armature resistance is (**4Ω**). (6 Marks)

Q6: A **static kramer drive** is used for the speed control of a slip ring induction motor (**SRIM**) fed from three phase ac supply, draw the circuit & show that steady state torque (write equations) is not influenced by whether a transformer is used or not. (12 Marks)

Good Luck