Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	ELECTRIC DRIVES
COURSE CODE	:	BEF 35803
PROGRAMME	:	BEV
EXAMINATION DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 (a) State three (3) examples of the equipment that their load torque is proportional to the square of speed.

(3 marks)

(b) A dragline hoist motor in a top of a tower is raising a 100 kg bucked. The hoist cable is wound on a motor drum with diameter of 50 cm. If power of the hoist motor is 20 kW and a high of the tower is 250 m.

(i) Determine the speed of the motor drum in rpm.

(4 marks)

(ii) Analyze duration time of the dragline to move the bucked from ground to top of the tower.

(3 marks)

(c) A single motor mounted on the front wheels drives of an electric vehicle (EV). The wheel diameter is 70 cm. The EV is going uphill at a maximum speed of 60 km/hr. Friction coefficient of the road surface at given weather condition is 0.4. Ignore the motor losses. The mass of the electric vehicle is 6000 kg, which included with the maximum passengers. The slope of the hill is 30^{o}.

(i) Sketch the forces acting on the EV.

(2 marks)

(ii) Predict the minimum power of the motor.

(5 marks)

(iii) Estimate the maximum speed of the EV in km/hr if used in horizontal road with friction coefficient of the road is 0.4.

(3 marks)

Q2 (a) State three (3) methods of speed control for a DC motor.

(3 marks)

(b) A separately excited dc motor has the rating of 200 V, 10 A and 1500 rpm. Resistance of the armature and field resistances are 0.5 Ω and 100 Ω respectively. The motor is used to drive a load whose torque is

$$T_L = 90 - 0.5\omega \quad \text{(Newton-meter)}$$

where ω is the motor speed in rad/s.

(i) Determine the motor speed (rpm), the load torque and the armature current when the voltage is reduced by 50 %.

(10 marks)

(ii) If the terminal voltage is constant at 200 V, analyze the resistance that should be added to the armature circuit (in series connection) to reduce the speed by 50 %.

(5 marks)

(iii) Determine the starting current of the motor for part Q.2.(b)(ii).

(2 marks)

Q3 (a) State three (3) breaking methods of DC motors.

(3 marks)

(b) A 10 kW dc shunt motor drives a constant-rated torque of 40 Nm. The armature and field resistances are 0.6 Ω and 100 Ω, respectively. The field constant K□ is 1.5 Vsec. The motor is driven by a full-wave controlled rectifier and the voltage source is 240 V, 50 Hz.

(i) If the trigger angle of the converter is 45° and the conduction angle is 135°, estimate the motor speed.

(6 marks)

(ii) Sketch the waveform of the voltage at motor terminal and the motor current waveform.

(4 marks)

(c) A 200 V, 900 rpm and 50 A separately exited dc motor as an armature and field resistances are 0.1 Ω and 20 Ω respectively. The motor is fed from a buck converter and the input of the converter is 200 V. The converter operated at continuous current mode. Estimate the duty ratio of the converter to reduce the motor speed by 50 % for motoring operation at rated torque.

(7 marks)

Q4 (a) State three (3) methods of speed control for a squirrel cage rotor induction motor.

(3 marks)

(b) A 440 V, 3-phase, 50 Hz, 6 poles, 945 rpm, delta connected squirrel cage induction motor has the following parameters with referred to the stator:

$$R_s = 2\Omega, R_r^{'} = 2\Omega, X_s = 3\Omega, X_r^{'} = 4\Omega, X_m = 100\Omega$$

The motor is used to drive a load whose torque is

$$T_L = \frac{N}{19} \text{ (Newton-meter)}$$

where N is the motor speed and ignore the rotational losses.

(i) Determine the motor speed and torque at nominal input voltage.

(8 marks)

(ii) If the motor operated at constant frequency, estimate the motor speed, and torque when the terminal voltage is reduced by 50 %.

(7 marks)

(iii) Determine the starting torque in part Q4(b)(ii).

(2 marks)

Q5 (a) Sketch the circuit of three phase AC voltage control for the three phase induction motor that used three phase anti-parallel SCR.

(3 marks)

(b) Sketch the circuit of a slip energy recovery for three phase wound-rotor induction motor control using static Kramer drive system.

(4 marks)

(c) If the induction motor in part Q4(b) is controlled by voltage control using anti-parallel SCR, analyze the firing angle of the SCR to operate the motor speed at 500 rpm.

(13 marks)

- END OF QUESTION –