



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017**

COURSE NAME : ELECTRIC DRIVES
COURSE CODE : BEF 35803
PROGRAMME : BEV
EXAMINATION DATE : JUNE 2017
DURATION : 2 HOURS 30 MINUTES
INSTRUCTION : ANSWER ALL QUESTIONS

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

Q1 (a) Explain and illustrate the principals of discontinuous conduction and continuous conduction of armature currents in DC motors by using appropriate diagram. (6 marks)

(b) A separately excited DC motor with specifications of 200 V, 850 rpm and 150 A has an armature resistance of 0.06Ω . It is fed from a single phase fully-controlled rectifier with an AC source of 240 V, 50 Hz. Assuming the motor is operated in continuous conduction operations, determine the following parameters.

(i) The firing angle when rated motor torque is considered and the motor speed is 750 rpm. (7 marks)

(ii) The firing angle when rated motor torque is considered and the motor speed is -500 rpm. (6 marks)

(iii) The motor speed when firing angle α is 160° . (6 marks)

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Q2 (a) Explain **two (2)** advantages of self-commutated semiconductor devices such as MOSFETs, IGBT, GTO and IGCT over thyristor devices for chopper applications. (4 marks)

(b) A separately excited DC motor has an armature resistance of 0.02Ω with specifications of 200 V, 1000 rpm and 200 A. The motor is fed from a chopper which provides both motoring and braking operations. The source voltage is 200V. Assuming the motor is operated in continuous conduction operation.

(i) Calculate duty ratio of chopper for motoring operation at rated torque and the motor speed is 500 rpm. (7 marks)

(ii) Calculate duty ratio of chopper for braking operation at rated torque and the motor speed is 400 rpm. (7 marks)

(iii) If the maximum duty ratio of the chopper is limited to 0.96 and the maximum permissible motor current is twice of the rated value, predict the value of maximum permissible motor speed obtained without consideration of field weakening and power fed to the source. (7 marks)

- Q3 (a)** A 400 V, 3-phase, 50 Hz, 6 poles and delta connected squirrel cage induction motor has the following parameters with referred to the stator:

$$R_s = R_r' = 2\Omega, X_{eq} = 10\Omega$$

The motor is used to drive a load whose torque is

$$T_L = \frac{N}{12} \quad (\text{Newton-meter})$$

where N is the motor speed and ignore the rotational losses. Determine the motor speed and torque at nominal input operation.

(10 marks)

- (b)** A three-phase 480 V, 60 Hz, 4 pole, Y-connected wound rotor induction motor has following parameters:

$$R_s = R_r' = 0.6\Omega, X_{eq} = 10\Omega$$

The motor is used to drive a constant load torque of 190 Nm.

- (i) Determine the motor speed at nominal input supply. (7 marks)
- (ii) If the motor operated at constant frequency, estimate the motor speed, and starting-torque when the terminal voltage is reduced by 50 %. (8 marks)

- Q4 (a)** Draw a circuit of three phase anti-parallel SCR of an AC voltage regulator for the Y-connected three phase induction motor. (3 marks)

- (b)** Design a block diagram of a closed loop three-phase induction motor drive system with the main power supply is fixed AC voltage, the control method is PID control and a variable voltage-variable frequency is generated from an inverter with sinusoidal PWM method and predict maximum output voltage of the inverter if the AC input supply is 415 V, 50 Hz and the modulation index of the sinusoidal PWM is $0 \leq M_a \leq 0.8$. (10 marks)

- (c)** List **three (3)** parts of the AC motor drive system in **Q4(a)** which are developed using digital controller board. (3 marks)

- (d) State **three (3)** applications of electric motor drives in an industry. (3 marks)
- (e) State **four (4)** element of the electric drive system in a modern AC electric locomotive. (4 marks)
- (f) Describe the function of opto-coupler in a gate driver. (2 marks)

- END OF QUESTIONS -

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