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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019**

COURSE NAME : MOTION CONTROL
COURSE CODE : BEH 41202
PROGRAMME CODE : BEJ
EXAMINATION DATE : DECEMBER 2018 / JANUARY 2019
DURATION : 2 HOURS 30 MINUTES
INSTRUCTION : ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

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- Q1** (a) An axis has a maximum velocity of 5m/sec and an acceleration/deceleration time of 2sec. The axis starts at 20m and travel until 60m.
- (i) Design a smooth trapezoidal motion profile. (8 marks)
- (i) Determine the motion time at 28 m. (6 marks)
- (b) Given the velocity profile in **Figure Q1(b)**, where all the segments have equal time,
- (i) Derive the formula for V_m as a function of time, t and position, S_c . (5 marks)
- (ii) Based on **Q1(b)(i)** calculate V_m if 2 sec and $S_c = 4$ cm. (1 marks)
- Q2** (a) Motor amplifier or drive is one of the main components in motion control system. Show clearly the functions of the motor amplifier or drive. (4 marks)
- (b) **Figure Q2(b)** shows the robotic arm used in manufacturing process that have three axis of motion and joints. Each of the joints has a maximum velocity of 25 degree/sec and the maximum accelerations are (10, 12.5, 12.5) degree/sec². Assuming all of the joints start at an angle of 90 degree and joints 1, 2 and 3 are moved to (10, 10, 160) degree respectively. Design the motion profiles by using:
- (i) Slew motion. (7 marks)
- (ii) Interpolation motion. (9 marks)

Q3 (a) Radio Control (RC) servomotor is a small device that has an output shaft that can be positioned to specific angular positions by sending the servo a coded signal usually a Pulse Width Modulation (PWM) signal. With the help of related graphs, explain how the position varies in RC servomotor with different pulse.

(7 marks)

(b) RC hobby servos are small actuators designed for remotely operating model vehicles such as cars, airplanes, and boats. Moreover, its ability to rotate and maintain at certain position or angle according to control pulses from a single signal wire also make servo motor popular in robot building.

(i) Construct a block diagram of RC servo motor with the major components.

(7 marks)

(ii) Produce a flow chart with explanation that demonstrate the motor operation.

(6 marks)

Q4 (a) Direct Current (DC) brushless motor operation is known to have same working principle with a stepper motor. Differentiate between the DC brushless motor and the stepper motor by considering the control system configuration, and speed/torque characteristics.

(8 marks)

(b) Programmable Motion Controller (PMC) is defined as the application of programmable hardware and software in conjunction with input sensory devices, actuator, data acquisition and microprocessor. Produce a comprehensive chart which represents the PMC development process with consideration of motion control components.

(12 marks)

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Q5 (a) A stepper motor is an electromechanical device which converts electrical pulses into discrete mechanical movements. With the help of related diagram, explain the operation of stepper motor below:

(i) Half stepping

(5 marks)

(ii) Microstepping

(5 marks)

(b) Direct Current (DC) motors have been used in industrial applications widely. DC motor can be classified into permanent magnet, series and shunt motor connection. Differentiate these motor classification in terms of its advantages, disadvantages and circuit connection.

(10 marks)

-END OF QUESTIONS –

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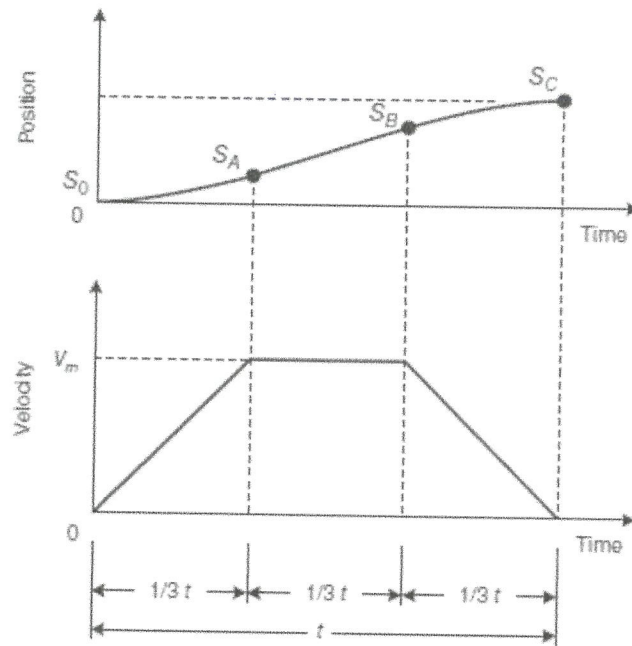


Figure Q1(b)

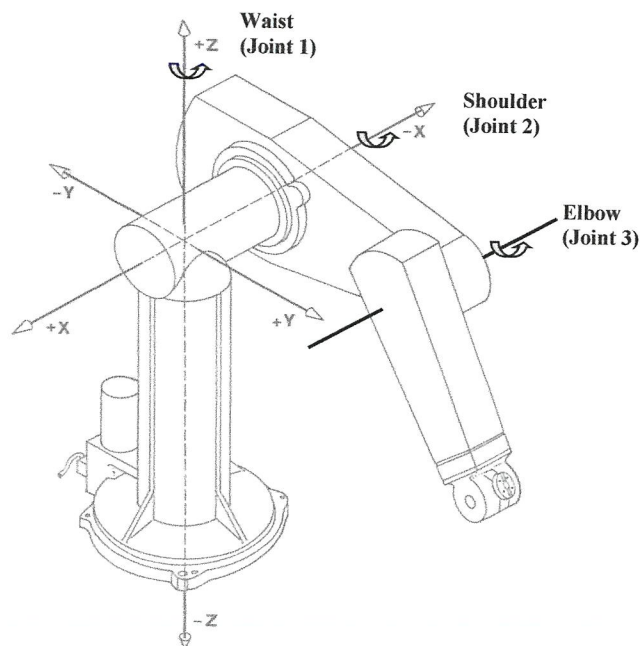


Figure Q2(b)

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