# ASSIGNMENT 1: WEEK 1 SOLUTION

**If not explained all symbols have same meaning as in the Lectures**

You can find the codes for Q4 at this link:
`https://github.com/roboticslabiisc/NPTEL-Robotics-Basics-and-Selected-Advanced-Concepts`

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1. The main features of a parallel robot is (are)

   (A) the existence of at least one loop.

   (B) no natural end-effector.

   (C) the links are in parallel.

   (D) the joints are in parallel.

   **Answer** : (A) and (B)

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2. The main advantage of using a stepper motor is (are)

   (A) that it can be more compact than all other kinds of electric motors for the same power output.

   (B) that it can give a much larger torque as compared to other electric motors of the same size.

   (C) that the rotation errors do not accumulate and hence can be used in open loop.

   (D) that it can be run at very high speeds.

   **Answer**: (C)

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3. The link of a robot is 1 m long. It is driven by a DC servo motor with an encoder used to measure rotation at the joint. What should be the number of bits in the encoder if the desired accuracy in positioning the end of the link is 0.1 mm?

   (A) 12 bit.

   (B) 14 bit.

   (C) 16 bit.

   (D) 18 bit.

   **Answer** : (C) 16 bit

   $r = 1$ m, $s = 0.1 \times 10^{-3}$ m

   $\therefore \theta = s/r = 0.1 \times 10^{-4}$ rads

   Total number of discrete positions required in one full turn $= N = 2\pi/\theta \approx 62832$

   The closest bit value to $N$ is 16-bit $= 2^{16} = 65536$

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4. Go to the link : `https://upload.wikimedia.org/wikipedia/commons/e/e9/16777216colors.png` and use this image to get the value of Red, Green, Blue at the pixel value (1561,1399). The value is nearby:

   (A) R = 147, B = 007, G = 145.

   (B) R = 097, B = 087, G = 248.

   (C) R = 037, B = 177, G = 048.

(D) R = 217, B = 213, G = 067.

**Answer** : (B) R = 097, B = 087, G = 248.

For the MATLAB code, visit the GitHub link provided at the beginning of the document.

5. In a DC motor driven using a PWM circuit

 (A) the applied voltage is varied linearly.

 (B) the applied voltage is kept at a constant value and the duty cycle is varied.

 (C) the duty cycle can be varied between 0 and 100 %.

 (D) The frequency of switching is kept very high ( > 20 kHz) so as not to cause audible noise.

**Answer** : (B) and (D)

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6. Which of the following devices is used to measure the rotational speed

 (A) Stroboscope.

 (B) Tachometer

 (C) Encoder

 (D) Gyroscope

**Answer** : (A) and (B)

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7. Which of the following devices is not a microprocessor

 (A) Raspberry Pi 4.

 (B) Teensy 4.0.

 (C) NVIDIA® Jetson Nano™.

 (D) Arduino Uno.

**Answer** : (B) and (D)

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8. Figure 1 shows the test result of a dart throwing robot. The blue '×' shows the darts thrown by the robot and the red circle is the intended target area. The conclusions that can be made about the robot are:

 (A) the robot is precise but not accurate.

 (B) the robot is precise and accurate.

 (C) the robot is accurate but not precise.

 (D) the robot is neither accurate nor precise.

**Answer** : (A)

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9. Which of the following are TRUE for rate gyro

 (A) Output proportional to angular rotation speed.

 (B) Can be integrated to obtain position.

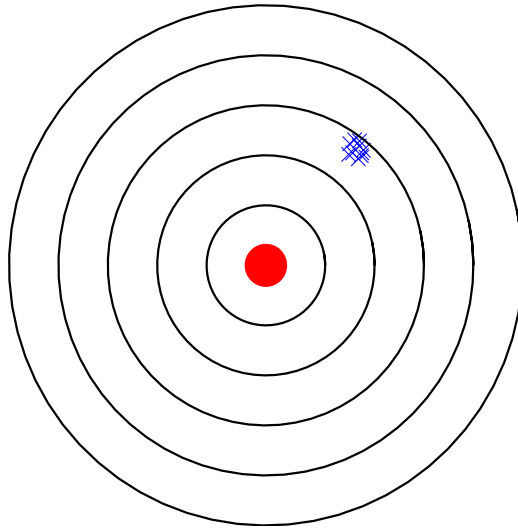 (C) Can be differentiated to obtain linear acceleration.

Figure 1: Test result for the robot

    (D) Cannot predict position or acceleration.

**Answer** : (A) and (B)

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10. Let us say you want to design a low-cost automated hand sanitizer to battle COVID-19. Which of the following sensor will best suit the purpose:

    (A) Camera.

    (B) Touch sensor.

    (C) LIDAR.

    (D) Ultrasonic sensor.

**Answer** : (D)

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