

**Question 1 – Multiple Choice Questions**

1. \_\_\_\_\_ is not an Embedded Computing device
  - a. STM32F4 Discovery
  - b. Microsoft Surface Pro
  - c. Arduino Nano
  - d. NodeMCUv1.0
2. You have received a power supply for your Arduino UNO, and it is having four-terminal outputs as 5.0VDC, 5.0VAC, 24.0VDC and 24.0VAC. What terminal is suitable for the requirement?
  - a. 5.0V AC
  - b. 5.0V DC
  - c. 5.0VAC & 24.0VAC
  - d. 5.0V DC & 24.0V AC
3. Arduino UNO has total \_\_ digital I/Os, \_\_ Analog Inputs, \_\_ PWM Outputs
  - a. 13, 5, 6
  - b. 13, 6, 6
  - c. 14, 5, 6
  - d. 14, 6, 6
4. There is an InfraRed (IR, 5.0VDC) sensor given to you and it has four (04) pins. Those are,
  - a. VCC, GND, AI, DI
  - b. VCC, GND, VDD, AI
  - c. VCC, GND, AO, DO
  - d. VCC, GND, VDD, AO
5. Which of the following designed system factors are not minimized for an embedded application?
  - a. Form factor
  - b. Cost
  - c. Performance
  - d. Quality of Service
6. Select the **THIRD law** of robotics.
  - a. A robot must destroy itself after functional life
  - b. A robot may not injure a human being or, through inaction, allow a human being to come to harm
  - c. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law
  - d. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

**Laws of Robotics**

0. A robot may not injure humanity, or, by inaction, allow humanity to come to harm.
1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey orders given it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.
7. What is the main **purpose** of introducing ROBOTS?
  - a. Substitute robots
  - b. Make repetitive tasks easy
  - c. Make human labor free industry
  - d. Substitute human
8. What does a robot have?
  - a. Brain
  - b. Life
  - c. Intelligence
  - d. Above all
9. Which of the following is the component of machine that is responsible for controlling a mechanism system?
  - a. Sensor
  - b. Middleware
  - c. Actuator
  - d. Transducer
10. Arduino is a \_\_\_\_\_.
  - a. Microcontroller based development board
  - b. An electronic prototyping platform
  - c. A robotic development platform
  - d. None of above
11. What is the best communication protocol to connect two arduino boards within 20 cm apart?
  - a. SPI
  - b. UART
  - c. I2C
  - d. None of the above
12. What is the **difference** between Arduino UNO and Arduino Mega?
  - a. Have different I/O configuration
  - b. Have different processing power

- c. Have different PWM Outputs
  - d. Above all
13. Line following robots usually follow a BLACK line on a WHITE background. Can we invert (WHITE line on a BLACK background) it without any hardware modification?
- a. Yes
  - b. No
  - c. Depend on IR sensors used
  - d. Depends on Microcontroller used
14. What is the optimum design for a line following robot DC Motor configuration?
- a. 04 DC Motors
  - b. 04 DC Motors with a Caster Wheel
  - c. 02 DC Motors
  - d. 02 DC Motors with a Caster Wheel
15. What is the range of IR sensor you used in line following robot?
- a. 1.0cm to 15.0cm
  - b. 1.0mm to 15.0mm
  - c. 1.0m to 15.0m
  - d. Above all
16. Standard color codes for power, ground & signal are,
- a. Red, Green, Blue
  - b. Blue, Brown, Black
  - c. Red, Black, Yellow
  - d. Green, Black, Yellow

## **Question 2: Embedded Systems**

1. What is an “Embedded System”?
2. Identify a system which was not fallen into the category of embedded system earlier, but now it is fallen into the category of embedded system. State the system that you identified and discuss three advantages been it an embedded system.
3. Draw a general block diagram of a typical embedded system hardware including all the key components.
4. Despite to microprocessors, microcontrollers are common in both embedded systems and robots. State the differences between microprocessors and microcontrollers considering four factors.

### Question 3: Arduino

Arduino is widely used electronic prototyping platform, which is widely used in robotics, embedded computing and IoT applications.

1. Introduce one of the Arduino development boards that you are familiar
2. Consider following Arduino sketch which is used to measure the distance by using HC-SR04 ultrasonic sensor.

```
const int trigPin = 5; // PWM trigger
const int echoPin = 3; // PWM Output
long duration; // defines variables
int distance;
void setup() {
    pinMode(trigPin, OUTPUT); //Sets the trigPin as an Output
    pinMode(echoPin, INPUT); // Sets the echoPin as an Input
    Serial.begin(9600); digitalWrite(trigPin, LOW);
}
void loop() {
    // Sets the trigPin on HIGH state for 10 micro seconds
    digitalWrite(trigPin, HIGH);
    delayMicroseconds(10);
    digitalWrite(trigPin, LOW); //Clears the trigPin
    duration = pulseIn(echoPin, HIGH); // Reads the echoPin, returns
the sound wave travel time in microseconds
    distance = duration * 0.034 / 2; // Calculating the distance
    Serial.print("Distance Measured="); // Prints the distance on
the Serial Monitor
    Serial.print(distance);
    Serial.println("cm");
}
```

Answer the following questions, considering the above program.

- a. What is the effect of “const” in line 1 and 2?
- b. What is the difference between “int” and “long”?
- c. The purpose of the instruction “Serial.begin(9600);”
- d.

### Question 4: Programming

Even though both robots and embedded systems are programmable devices like general computers, they must be carefully programmed due to limitations of computational hardware.

1. State three constraints that must be considered programming embedded devices or robots
2. Considering one of the constraints in part 1, how do you overcome the constraint in programmer’s viewpoint?
3. Interrupt is one of the methods to identify external events. Explain three types of hardware interrupt detections used in Arduino with added timing diagrams.

4. Discuss the advantages of using timers over delays in Arduino programming

### **Question 5: Robotics**

Three main categories of robots are Mobile Robots, Robotic Manipulators, and Humanoid Robots. are

1. Comparatively, discuss the difference among these three types by considering following factors
  - a. Mobility
  - b. Applications
  - c. Power Supply
2. State an example for each type of the above type of robots
3. “Autonomous vehicles are (will be) become part of over life”. Discuss the possible advantages and disadvantages of replacing traditional transportation by autonomous vehicles.
4. Briefly discuss how to make a simple line following robot having ability to navigate through followings
  - a. Straight lines
  - b. Bends
  - c. Junctions ( T L Y + )