Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem & AY: Odd Sem. 2019-20 | **Date**: 27.09.2019

Course Code: MEC 313 | **Time**: 9:30AM - 10:30AM

Course Name: ROBOTICS | **Max Marks**: 40

Program & Sem: B.Tech. (MEC) & VII DE | **Weightage**: 20%

Instructions:

*(i) **Read the question properly and answer accordingly.***

*(ii) **Question paper consists of 3 parts.***

Part A (Memory Recall Questions)

Answer all the Questions. Each Question carries four marks. (4Qx3M=12M)

1. What is Robot? What are the applications of Robotics? (C.O.NO.1)[Knowledge]
2. What is Work volume of Robot? What are the factors considered for determining work volume of Robot? (C.O.NO.1)[Knowledge]
3. Classify Robots based on control systems adopted and Identify which is suitable for spot welding process. (C.O.NO.1)[Knowledge]
4. Define Proprioceptive and Exteroceptive sensors with two examples each. (C.O.NO.2) [Knowledge]

Part B (Thought Provoking Questions)

Answer both the Questions. Each Question carries eight marks. (2Qx8M=16M)

5. Illustrate the working of Cartesian type robotic configuration. (C.O.NO.1) [Comprehension]
6. Explain the mechanism of opening and closing of Mechanical grippers with suitable sketch. (C.O.NO.1) [Comprehension]

Part C (Problem Solving Questions)

Answer the Questions. Each Question carries twelve marks. (1Qx12M=12M)

7. Identify best suitable robotic configuration for the spray painting process and with a neat sketch explain its working and name any 2applications.

(C.O.NO.1) [Comprehension]

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BENGALURU

SCHOOL OF ENGINEERING

TEST - 2

Sem & AY: Odd Sem 2019-20
Course Code: MEC 313
Course Name: ROBOTICS
Program & Sem: B. Tech & VII (DE)

Date: 16.11.2019
Time: 9.30 AM to 10.30 AM
Max Marks: 40
Weightage: 20%

Instruction: ***All questions are compulsory to attend.***

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries four marks. (4Qx4M=16M)

1. What is tactile sensor. Briefly explain its types. (C.O.NO.2) [Knowledge]
2. Define actuator. Also gives its classification. (C.O.NO.3) [Knowledge]
3. Briefly explain robotic vision and also gives its applications. (C.O.NO.2) [Knowledge]
4. Explain capacity proximity sensor with neat sketch diagram. (C.O.NO.2) [Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries seven marks. (2Qx7M=14M)

5. Explain the working of optical sensor with neat sketch diagram. (C.O.NO.2) [Knowledge]
6. Differentiate among Hydraulic, Pneumatic and Electrical actuators. Give any seven point. (C.O.NO.3) [Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The Question carry ten marks. (1Qx10M=10M)

7. Why robot is required in welding application? Also explain the features of welding robot. (C.O.NO.3) [Comprehension]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: VII
Course Code: MEC 313
Course Name: Robotics

Date: 16/11/19
Time: 9:30 AM to 10:30 AM
Max Marks: 40
Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1.	CO2	UNIT 2		4								4
2.	CO3	UNIT 3		4								4
3.	CO2	UNIT 2		4								4
4.	CO2	UNIT 2		4								4
5.	CO2	UNIT 2					7					7
6.	CO3	UNIT 3					7					7
7.	CO3	UNIT 3							10			10
	Total Marks											40

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

Annexure- II: Format of Answer Scheme

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

SOLUTION

Semester: VII

Course Code: MEC 313

Course Name: Robotics

Date: 16/11/19

Time: 9:30 AM to 10:30 AM

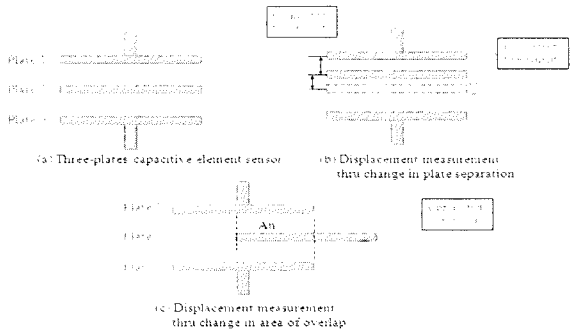
Max Marks: 40

Weightage: 20%

Part A (4Q x 4M = 16Marks)

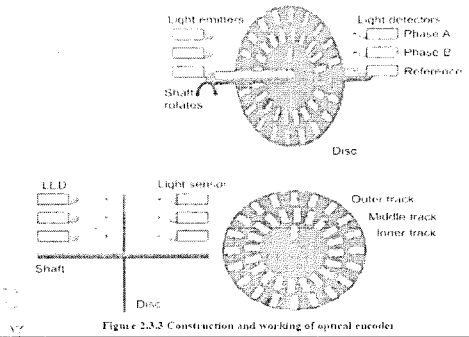
Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	Tactile sensors are devices which indicate contact between themselves and some other solid object. Tactile sensing devices can be divided into two classes touch sensors and force sensors. **Touch sensor:-** Touch sensors provide a binary output signal which indicates whether or not contact has been made with the object. Included within this category are simple devices such as limit switches, micro switches etc. It can be used to indicate the presence or absence of parts in a fixture. Another use for a touch sensing device would be as part of an inspection probe which is manipulated by the robot to measure dimensions on a work part. **Force and Torque sensors:-** Force and Torque sensors are used primarily for measuring the reaction forces developed at the interface between mechanical assemblies. The principal approaches for doing this are joint and wrist sensing. A joint sensor measures the Cartesian components of force and torque acting on a robot joint and adds them vectrorially. Force sensors indicates not only that contact has been made with the object but also the magnitude of the contact force between the two objects.	**2 Marks for definition and 1 marks for each type**	4

	The capacity to measure forces permits the robot to perform a number of tasks. These include the capability to grasp parts of different sizes in material handling, machine loading and assembly work.		
2	An actuators are devices used to produce action or Motion. For robots, actuators are like muscles that perform work. The work can be either to induce motion, or to object motion; i.e. either to start a movement, or to stop it. There are different types of actuators available and most of them either create rotational motion, or linear motion. • **Based on motion produced** 1) Linear Actuators 2) Rotary Actuators • **Based on Energy utilized in actuator** 1)Hydraulic Actuators 2)Pneumatic Actuators 3)Mechanical Actuators 4)Electric Actuators	**2 Marks for definition and 2 marks classification**	4
3	1. Most vision systems are equipped with one or more video cameras linked to a vision processor. 2. The vision processor digitizes the camera image and analyzes it to define the object. 3. The typical vision system consist of the camera and digitizing hardware, a digital computer and hardware and software necessary to interface them. This interface hardware and software is often referred to as a preprocessor. 4. The main applications of vision systems are in handling, assembly part classification and inspection. 5. In handling, assembly part classification and inspection systems are used to recognize the position and orientation of objects to be handled or assembled. 6. These systems can also determine the presence or absence of parts and detect particular features of the object (for ex: diameter). **Applications** 1. The third function of a machine vision system is the applications function. 2. The current application of machine vision in robotics include inspection, part identification, location and orientation.	**3 marks for each vision and 1 marks for application**	4
4	Capacitive sensor is of non-contact type sensor and is primarily used to measure the linear displacements from few millimeters to hundreds of millimeters.	**2 marks for explanation and 2 Marks for diagram**	5

	It comprises of three plates, with the upper pair forming one capacitor and the lower pair another. The linear displacement might take in two forms: One of the plates is moved by the displacement so that the plate separation changes. Area of overlap changes due to the displacement.  (a) Three-plates capacitive element sensor (b) Displacement measurement thru change in plate separation Δx (c) Displacement measurement thru change in area of overlap		

Part B

(2Q x7M = 14Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
5	**Optical sensors:-** • Optical encoders provide digital output as a result of linear / angular displacement. These are widely used in the Servo motors to measure the rotation of shafts. • Figure shows the construction of an optical encoder. It comprises of a disc with three concentric tracks of equally spaced holes. Three light sensors are employed to detect the light passing thru the holes. • These sensors produce electric pulses which give the angular displacement of the mechanical element e.g. shaft on which the Optical encoder is mounted. The resolution can be determined by the number of holes on disc. With 100 holes in one revolution, the resolution would be, $360^0/100 = 3.6^0$.  Figure 2.3.3 Construction and working of optical encoder	4 Marks for explanation and 3 marks for diagram	4

6		1 marks for each point	5

Characteristics	Pneumatic	Hydraulic	Electric
Complexity	Simple	Medium	Medium/High
Peak power	High	Very high	High
Size	Low size/force	Very low size/force	Medium size/force
Control	Simple valves	Simple valves	Electronic controller
Position accuracy	Good	Good	Better
Speed	Fast	Slow	Fast
Purchase cost	Low	High	High
Operating cost	Medium	High	Low
Maintenance cost	Low	High	Low
Utilities	Compressor/power/ pipes	Pump/power/ pipes	Power only
Efficiency	Low	Low	High
Reliability	Excellent	Good	Good
Maintenance	Low	Medium	Medium

Table: IX: Linear Power Transmission Comparison

Part C (1Q x 10M = 10Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
7	1. Arc welding is performed by skilled workers who are assisted by a person called fitter 2. The working condition of the welder is typically unpleasant and hazardous. 3. The arc from the welding process emits ultra-violet radiations which is injurious to human vision. 4. Because of the hazards for human workers in continuous arc welding, it is logical to consider industrial robots for the purpose.	4 marks for joint, 3 marks for diagram and 3 marks for explanation	6

14.2.3 Features of the Welding Robot

An industrial robot that performs arc welding must possess certain features and capabilities. Some of the technical considerations in arc-welding applications are discussed in the following:

1. Work volume and degrees of freedom The robot's work volume must be large enough for the sizes of the parts to be welded. A sufficient allowance must be made for manipulation of the welding torch. Also, if two part holders are included in the workstation, the robot must have adequate reach to perform the motion cycle at both holders. Five or six degrees of freedom are generally required for arc-welding robots. The number is influenced by the characteristics of the welding job and the motion capabilities of the parts manipulator. If the parts manipulator has two degrees of freedom, this tends to reduce the requirement on the number of degrees of freedom possessed by the robot.

2. Motion control system Continuous-path control is required for arc welding. The robot must be capable of a smooth continuous motion in order to maintain uniformity of the welding seam. In addition, the welding cycle requires a dwell at the beginning of the movement in order to establish the welding puddle, and a dwell at the end of the movement to terminate the weld.

3. Precision of motion The accuracy and repeatability of the robot determines to a large extent the quality of the welding job. The precision requirements of welding jobs vary according to size and industry practice, and these requirements should be defined by each individual user before selecting the most appropriate robot.

4. Interface with other systems The robot must be provided with sufficient input/output and control capabilities to work with the other equipment in the cell. These other pieces of equipment are the welding unit and the parts positioners. The cell controller must coordinate the speed and path of the robot with the operation of the parts manipulator and the welding parameters such as wire feed rate and power level.

5. Programming Programming the robot for continuous arc welding must be considered carefully. To facilitate the input of the program for welding paths with irregular shapes, it is convenient to use the walkthrough method in which the robot wrist is physically moved through its motion path. For straight welding paths, the robot should possess the capability for linear interpolation between two points in space. This permits the programmer to define the beginning and end points of the path and the robot is capable of computing the straight line trajectory between the points.

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GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20

Course Code: MEC 313

Course Name: ROBOTICS

Program & Sem: B.TECH (MEC) & VII (DE-III)

Date: 20 December 2019

Time: 9:30 AM to 12:30 PM

Max Marks: 80

Weightage: 40%

Instructions:

(i) Read the all questions carefully and answer accordingly.

(ii) All questions are compulsory to attend.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 04 marks. (4Qx5M=20M)

1. Differentiate between Active and passive sensors. (C.O.No.1) [Knowledge]
2. Explain control resolution, accuracy and repeatability attributes regarding a robot. (C.O.No.2) [Knowledge]
3. Briefly explain the VAL language used in industrial robot. (C.O.No.3) [Knowledge]
4. Briefly explain the components required to make a robot. (C.O.No.4) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 10 marks. (3Qx10M=30M)

5. Explain any four programming method to teach a robot to do a given task. (C.O.No.3) [Knowledge]
6. What are the physical characteristics required for determining a work volume. Also give work volume for all types of configuration robot with neat sketch diagram. (C.O.No.1) [Knowledge]
7. Which type of sensor used for continuous and discrete data. Explain them with their attributes. (C.O.No.2) [Knowledge]

Part C [Problem Solving Questions]

Answer both the Questions. Each Question carries 15 marks. (2Qx15M=30M)

8. Briefly explain the working of pick and place robot and also mention major parts required to construct it. (C.O.No.3) [Comprehension]
9. Briefly explain about the main components required to make an obstacle avoiding robot with its working operation. (C.O.No.4) [Comprehension]

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	CO 1 (6.25)	1	5			05
2	CO 2 (6.25)	2	5			05
3	CO 3 (6.25)	3	5			05
4	CO 4 (6.25)	4	5			05
5	CO 4 (12.5)	4		10		10
6	CO 1 (12.5)	1		10		10
7	CO 2 (12.5)	2		10		10
8	CO 3 (18.75)	3			15	15
9	CO 4 (18.75)	4			15	15
	Total Marks		20	30	30	80

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

Reviewer Commend:

Format of Answer Scheme

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

SOLUTION

Semester: Odd Sem. 2019-20
Course Code: MEC 313
Course Name: ROBOTICS
Program & Sem: B.TECH (MEC) &VII (DE-III)

Date: 20.12.2019
Time: 3 HRS
Max Marks: 80
Weightage: 40%

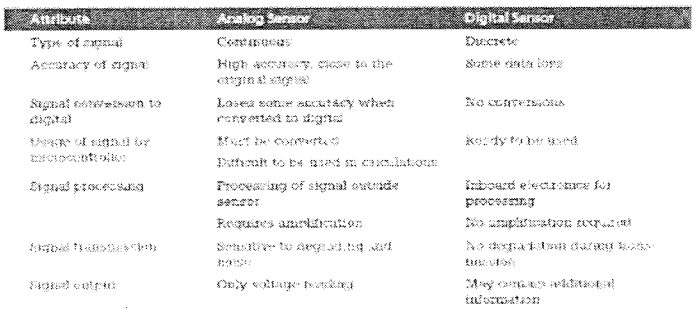
Part A (4Q x 5M = 20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Questio
1	**2.3 Classification of Sensors based on Power Supply** Active and passive sensors describe how the sensors make measurements and how they meet their power requirements. Passive sensors receive energy from their environment or from the object to be measured. Passive sensors have no effect on their surroundings or whatever they are measuring. This is especially useful when robots are to be inconspicuous in a given scenario. Passive sensors are considered nonintrusive and energy efficient. Active sensors involve direct interaction with their environment. They make observations by emitting energy into the environment and therefore require a power source. They are less energy efficient but are more robust because they are less affected by the available energy sources. Table-2: Active and Passive Sensor	**2.5 marks for each sensor**	**8**

2	**Control Resolution(spatial resolution)** - This is the smallest change that can be measured by the feedback sensors, or caused by the actuators, whichever is larger. If a rotary joint has an encoder that measures every 0.01 degree of rotation, and a direct drive servo motor is used to drive the joint, with a resolution of 0.5 degrees, then the control resolution is about 0.5 degrees (the worst case can be 0.5+0.01). **Accuracy** –Accuracy refers to a robot's ability to position its wrist end at a desired target point within the work volume. **Repeatability** –Repeatability is concerned with the robot's ability to position its wrist or an end effector attached to its wrist at a point in space that had previously been taught to the robot.	**First point carries 2 marks remaining point carry 1.5 marks**	**8**
3	• The VAL language was developed for PUMA robot • VAL stands for Victors Assembly Language • It is basically off-line language in which program defining the motion sequence is can be developed off-line but various point location used in the work cycle are defined by lead through. • VAL statements are divided into two categories a) Monitoring command b) Programming instructions. • Monitor command are set of administrative instructions that direct the operation of the robot system. Some of the functions of Monitor commands are 1.Preparing the system for the user to write programs for PUMA 2.Defining points in space 3.Commanding the PUMA to execute a program 4.Listing program on the CRT • Examples for monitor commands are: EDIT, EXECUTE, SPEED, HERE etc. • Program instructions are a set of statements used to write robot programs. One statement usually corresponds to one movement of the robots arm or wrist. • Example for program instructions are Move to point, move to a point in a straight line motion, open gripper, close gripper. (MOVE, MOVES, APPRO, APPROS, DEPART, OPENI, CLOSEI, AND EXIT)	**5 marks for explanation with example of commands**	**10**
4	Any robot is made from a collection of various hardware components:- **Locomotion** – how the robot moves within the environment. E.g. Wheels or Legs. **Sensing** – how the robot obtains information about itself and the current state of the environment. E.g. Camera or Ultra-Sonic Range Finder. **Reasoning** – how the robot utilises the information obtained from its sensors to form decisions and actions. E.g. Reactive Controller or Computer running AI program. **Communication** – how the robot communicates to a human or machine operator and vice versa. E.g. Remote Control, Text Interface or Video Link.	**4 point 4 marks**	

Part B (3Q x 10M = 30 Marks)

	Solution	Scheme of Marking	Max. Time required for

Q No			each Question
5	There are various methods which robots can be programmed to perform a given work cycle. We divide this programming method into four categories. 1. Manual method 2. Walkthrough method 3. Lead through method 4. Off-line programming	each one carry 2.5 marks	15
6	Work volume is the term that refers to the space within which the robot can manipulate its wrist end. The work volume is determined by the following physical characteristics of the robot 1) The robots physical configuration 2) The size of the body, arm and wrist components. 3) The limits of the robots joint movements **There are four common robot configuration or body and arm assembly**(configuration means an arrangement of parts or elements in a particular form 1. Polar configuration 2. Cylindrical configuration 3. Cartesian coordinate configuration 4. Jointed arm configuration	2 marks for characteristics and 8 marks for each work volume with diagram	15
7	Analog and digital are the most basic sensor classifications that describe how a sensor measures. A digital sensor produces a non continuous discrete output signal, and an analog sensor creates a signal that has a continuous value. Analog sensors are meant to help convert real-world information that isn't electrical. Both types of sensors' output will be represented in a digital format recognizable by a processor. Some sensors do not directly turn their signals into digital signals but instead create an analog signal that is converted later.  Table-1: Attributes of Analog and Digital Sensor	For identification 2 marks and 8 marks for attributes	15

Part C (2Q x 15M = 30Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question

8	A pick and place robot is the one which is used to pick up an object and place it in the desired location. It can be a cylindrical robot providing movement in horizontal, vertical and rotational axes, a spherical robot providing two rotational and one linear movement, an articulate robot or a scara robot (fixed robots with 3 vertical axes rotary arms). Parts **A Rover:** It is the main body of the robot consisting of several rigid bodies like a cylinder or a sphere, joints and links. It is also known as a manipulator. **End Effector:** It is the body connected to the last joint of the rover which is used for the purpose of gripping or handling objects. It can be an analogy to the arm of a human being. **Actuators:** They are the drivers of the robot. It actually actuates the robot. It can be any motor like servo motor, stepper motor or pneumatic or hydraulic cylinders. **Sensors:** They are used to sense the internal as well as the external state to make sure the robot functions smoothly as a whole. Sensors involve touch sensors, IR sensor etc. **Controller:** It is used to control the actuators based on the sensor feedback and thus control the motion of each and every joint and eventually the movement of the end effector		
9	A simple project on Obstacle Avoiding Robot is designed here. Robotics is an interesting and fast growing field. Being a branch of engineering, the applications of robotics are increasing with the advancement of technology. The concept of Mobile Robot is fast evolving and the number of mobile robots and their complexities are increasing with different applications. There are many types of mobile robot navigation techniques like path planning, self – localization and map interpreting. An Obstacle Avoiding Robot is a type of autonomous mobile robot that avoids collision with unexpected obstacle in this project, an Obstacle Avoiding Robot is designed. It is an Arduino based robot that uses Ultrasonic range finder sensors to avoid collisions. **Hardware required** • Arduino Uno • Ultrasonic Range Finder Sensor – HC – SR04 • Motor Driver IC – L293D • Servo Motor (Tower Pro SG90) • Geared Motors x 2 • Robot Chassis • Power Supply • Battery Connector • Battery Holder **Working** Before going to working of the programme, it is important to understand how the ultrasonic sensor works. The basic principle behind the working of ultrasonic sensor is as follows:		

	Using an external trigger signal, the Trig pin on ultrasonic sensor is made logic high for at least 10μs. A sonic burst from the transmitter module is sent. This consists of 8 pulses of 40KHz. The signals return back after hitting a surface and the receiver detects this signal. The Echo pin is high from the time of sending the signal and receiving it. This time can be converted to distance using appropriate calculations. The aim of this project is to implement an obstacle avoiding robot using ultrasonic sensor and Arduino. All the connections are made as per the circuit diagram. The working of the project is explained below		