



**8. Write the classification by control method?**

- a. (i) Non – servo controlled (ii) Servo controlled

**9. What are the four basic configurations in Robots?**

- a. Basic configurations of robots are  
b. Cartesian configuration (Allow three (degree of freedom) DOF in translations only)  
c. Cylindrical configuration (3 DOF Two linear and one Rotation )  
d. Polar configuration (3 DOF Two Rotation and one linear)  
e. Joint arm configuration ( 3 DOF Three Rotations)

**10. What are the major components of a Robot?**

- a. The manipulator, Sensors,  
b. Controllers, Power conversion unit.

**11. Define Manipulator?**

- a. The manipulator consist of a series of rigid members called links, connected by joints the interface between the last link and the tool or end effectors is called the tool mounting plate. It consists of major linkages, minor linkages & end effectors.

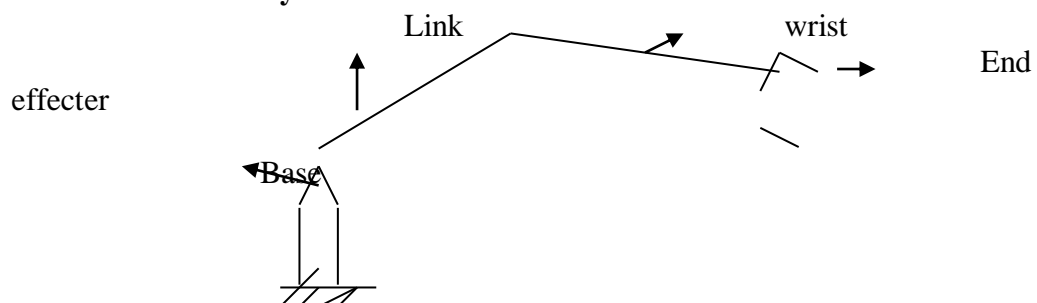
**12. What are the different types of drive system used in robots?**

- a. Drive system used are  
b. Electric drive system is used for smaller size Robots  
c. Hydraulic drive system is used for large size Robots  
d. Pneumatic drive system is used for smaller Robot which has few DOF. (degree of freedom)

**13. Define controller functions:-**

- a. They initiate and terminate the motion of the individual components of the manipulator in a desired sequence and at a specified point.  
b. They store position and sequence data in their memory.  
c. They permit the robot to be interfaced to the outside world via sensors mounted in the area where world is being performed.

**14. Draw Robot anatomy?**



**15. Define degrees of freedom? (DOF)**

- a. The numbers of independents movements that an object can perform in a 3D space is called the DOF.

**16. What are types of joints?**

Revolute joint (R) :- Two links are jointed by a pin about the axis of which the links can relate with respect to each other.

Prismatic joint (P):- Two links are so jointed that these can slide with respect to each other.

(c) Rotary joint: - one link rotates about the other at  $90^0$  angle.

Twist joint (T) Two links are connected along a straight line but one turns about the other around the link axis.

**17. Write different type of manipulator?**

- a. Spatial manipulator:- 6DOF – 3 for position
  - i. 3 for orientation.
- b. Planar manipulator:- 3DOF – 2 for position
  - i. 1 for orientation

**18. Define work space, work volume & work envelope?**

- a. Work space the portion of space around the base of the manipulator that can be accessed by arm end point.
- b. Work volume-the volume of the space swept is called work volume.
- c. Work envelope- the surface of workspace describes the work envelop

**19. Define pitch, roll and yaw of robot wrist?**

- a. Pitch-motion in a vertical plane passing through the arm.
- b. Roll- A 3 DOF wrist permitting rotation about three perpendicular axes provides for roll (motion in a plane perpendicular to the end of the arm).
- c. Yaw – motion in a horizontal plane that also passes through the arm

**20. What is meant by end effectors?**

- a. It is a device that attaches to the wrist of the arm and enables the robot to perform a specific task. It is hand of robot. It also called robot' s hand.

**21. What is dexterous envelope?**

- a. Envelope of all points which can reach with an arbitrarily specified orientation.

**22. What is meant by speed of response and stability in robots?**

- a. Speed of response refers to the capability of the robot to move to the next position in a short amount of time. This response time is related to robot motion.
- b. Stability of robot can be controlled to a certain extent by incorporating damping elements.

**23. Elements of a Robot system?**

Mechanical components: A manipulator, End of arm tooling, actuators, transmission elements.

Control system: - mechanical, hydraulic, pneumatic control, sensors, equipment interfaces.

Computer system:- microprocessor (or) personal computer user interface, control software

**24. What is compliance?**

A compliance of robot manipulator refers to the displacement of the wrist end in response

- a. To a force or forgive exerted organist it. Compliance may high or low.
  1. High compliance means, the wrist is displaced a large amount by a relatively small force.

2. Low compliance means, manipulators is relatively still and not displaced by a significant amount.

**25. Write the possible type of paths?**

- a. 4 path & 8path  
 b. 4 path – 4 connection,                      8 path – 8 connection

**26. What is world co-ordinate , model co-ordinates?**

Absolute co-ordinates are also called world co-ordinates.

Individual objects may have their own co-ordinate system called model co-ordinates.

**27. What is zeroth law of robotics ?**

- a. A robot must not injure humanity or through inaction, allow humanity to come to harm.

**UNIT □ II**

**28. What are the types of end effectors?**

Grippers – used to grasp and hold objects.

Tools – designed to perform work on the part rather than to merely grasp it.

1. Eg. Spot welding, spray painting etc.

**29. Write the classification of grippers?**

- i. Grippers - Single grippers                      Double grippers                      Multiple grippers  
 1. Internal grippers                      External grippers.

**30. What is mechanical gripper?**

- a. Mechanical gripper is an end effector that uses mechanical fingers actuated by mechanism to grasp an object. The fingers, some times called jaws are the appendages of the gripper that actually make contact with the object. The fingers are either attached to the mechanism or are an integral part of the mechanism.

**31. Write the function gripper mechanism?**

- a. It is to translate some form of power input into the grasping action of the fingers against the part. The power input is supplied from the robot and can be pneumatic, electric, mechanical or hydraulic. It is used to open and close the fingers and to exert sufficient force against the part when closed to hold it securely.

**32. Write the two ways of constraining the part in the gripper?**

Physical constriction of the part with in fingers.

Friction between the fingers and the work part.

**33. Write the gripper force formula?**

i.  $n_f F_g = w_g$

- ii. = coefficient of friction of the finger contact surface against the part surface.

$n_f$  = no. of contacting fingers.

$F_g$  = gripper force

W – Weight of the part being gripped.

g – Combined effect of gravity and acceleration

g = 3 if acceleration force is applied in the same direction as gravity force.

g = 1 if it opposite.

**34. Write types of mechanical grippers?**

Linkage actuation of mechanical grippers

Gear and rack actuation of mechanical grippers

Cam actuation of mechanical grippers

Screw actuation of mechanical grippers

Rope and pulley actuation of mechanical grippers

Miscellaneous. of mechanical grippers

**35. Write the type of grippers other than mechanical?**

a. Vacuum

b. Magnetic gripper

c. Adhesive gripper

d. Hooks, scoop, miscellaneous devices.

**36. Write the lift capacity vacuum grippers?**

Vacuum cup – the surface should smooth flat and clean.

Its lift capacity is  $F = PA$

F - Force of lift capacity

P – Negative pressure

A – Total effective area of suction cups to create vacuum.

**37. What are advantages of suction gripper?**

Requires only one surface of the part for grasping.

Applies a uniform pressure distribution on the surface of the part.

Relatively light weight grippers.

Applicable to variety of different materials.

**38. Write the advantages of magnetic grippers?**

used to lift ferrous materials.

Pickup times are very fast.

Variations in part size can be tolerated. gripper does not have to be designed for one particular work part.

Ability to handle metal parts with holes.

Require only one surface for gripping.

**39. Write the functions when end effectors interface with robot?**

physical support of the end effectors during the work cycle must be provided.

Power to actuate the end effectors must be supplied through the interface.

Control signals to actuate the end effectors must be provided. Feedback signal must sometimes be transmitted back through the interface to the robot controller.

**40. Write actuation and feedback components of robots?**

a. Feedback components are velocity sensors and position sensors give feed back to the input.

b. Actuators and power transmission devices are used as control action indicated by the controller.

**41. Base frame define?**

- a. To describe position and orientation of a body in space, a frame attached to the body, the Position and orientation of this frame with respect to some reference co-ordinate frame called base frame, which mathematically describes the location of the body.

**42. Write the use of spatial geometry?**

- a. The position and orientation of links in space and their motions are described by spatial geometry.

**43. Define co-ordinate frame?**

In a 3D – space, a co-ordination frame is a set of three orthogonal right hand axes X,

- i. Y, Z called principal axes, with “ O” as origin.
- ii. The frame is labeled as {x, y, z} or {1}.

**44. Write the difference between translation & Rotation?**

- |  |                            |
|--|----------------------------|
| a. Translation                           | Rotation                   |
| b. The origin of two frame               | the origin of two frame is |
| c. is different.                         | same.                      |
| d. Represented in 3D space by 3X1 vector | by 3 X 3 rotation matrix.  |

**45. Define joint parameter?**

Joint distance ( $d_i$ ) is the perpendicular distance between the two adjacent common normal  $a_{i-1}$  and  $a_i$  measured along axis ( $i - 1$ ).

Joint angle ( $\theta_i$ ) is the angle between two adjacent common normal  $a_{i-1}$  &  $a_i$  measured in right handed direction about the axis ( $i - 1$ ). It is the rotation about joint axis ( $i - 1$ ). Needed to make  $a_{i-1}$  parallel to  $a_i$ :

**46. What is the configuration of end effectors?**

- a. The position and orientation of the end effectors is collectively referred to as configuration of end effector.

**47. What is configuration (or) cartesian space?**

- a. The six components, ie three position components as displacements along three orthogonal axes of base frame and three rotations about the base frame axes, can be represented by a six dimensional space.

**48. Define frame?**

- a. Frame is a co-ordinate system, where in addition to the orientation we give a position vector. Which locates its origin relative to some other embedding frame.

**49. Write the task of robot program?**

The task of robot program is to control the motions and actions of the manipulator. Programs must also be written to deal with both user and machines.

**50. Write the functions of robot programming?**

- Modeling the workspace.
- Path generation
- Sensing

Programming support.

**51. What are the features and capabilities of second generation language?**

Motion control  
Advanced sensor capabilities  
Limited intelligence  
Communications and data processing

**52. What is meant by operating system in robot language?**

- a. The language requires that there be some mechanism that permits the user to determine whether to write a new program, edit an existing program, execute a program or perform some other functions.

**53. What is frame technique in knowledge representation?**

- a. Frames are the predefined structures with empty slots which are filled to represent the specific facts.

**54. What is state space problem representation?**

- a. In this method we can visualize the problem of all of the possible states found in developing the solution configured as a tree. The tree is made of nodes, which represent the states of the system after certain actions have been taken. This action are represented by the arcs that connect the nodes.

**55. What is problem reduction representation?**

- a. The goals is represented as primary data item and then reduce the problem until we have a set of primitive problems, that is simpler problems for which we have the data available, is called problem reduction representation.

**UNIT □ III**

**56. What is artificial intelligence?**

- a. Artificial intelligence is the part of computer science concerned with the characteristic we associate with intelligence in human behavior – understanding language, learning , reasoning , solving problems and so on.

**57. List out the areas where AI research is perused?**

Problem solving  
Natural language  
Expert systems  
Learning  
Vision

**58. In which task AI technique must be developed?**

AI technique must be developed for two basic tasks:-  
Data representation  
Data manipulation

**59. Which type of knowledge of requires representation?**

Objects – more specifically fact about object such as birds have wings.  
Events:-  
Performance – if the AI system is one which is designed to control robot then it must have data on the performance of the arm, that is its kinematics, dynamics, what bits to manipulate in the hardware, and so on.

Meat knowledge :-

- a. This is knowledge about our about knowledge. This includes our knowledge of the origin of the information, its relative importance, its reliability & soon.

**60. What are techniques used for knowledge representation?**

- logic
- procedural representations
- Semantic networks.
- Production systems
- Frames

**61. What is problem solving give example?**

- a. It is the task of sending some specified good examples of these goals may be.
  - Finding the proof to a MN the metrical theorem
  - Solving a puzzle, such as Rubik' s cube.
  - Determining a sequence of assembly steps.
  - Choose the next move in a chess game.

**62. Write the methods used for problem representation.**

- state – space representation
- problem reduction representation

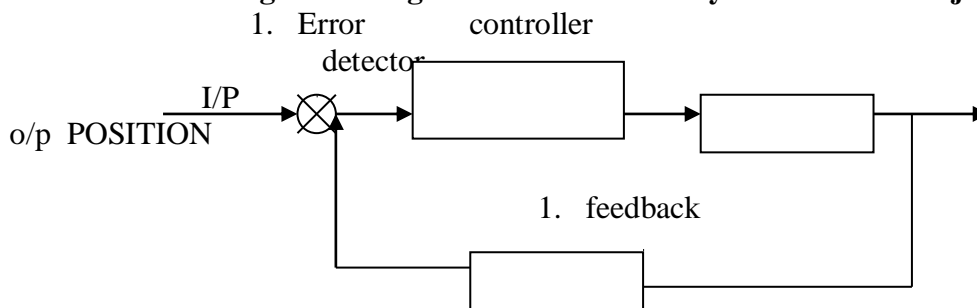
**63. Give the different search techniques used in problem solving.**

- a. a. depth first search
- b. Breath first search
- b. c. hill climbing
- d. Best first search
- c. e. branch and band
- f. Constraints.

**64. What is robot dynamics?**

- a. The robot dynamics is concerned with the analysis of the torques and forces due to acceleration and deceleration. Torque experienced by the joint due to acceleration of the links and force experienced by the links due to torques applied by the joints are considered.

**65. Draw the block diagram configuration of a control system for a robot joint?**



**66. Represent point p in homogeneous co ordinate?**

- a.  ${}^i P = \begin{pmatrix} P_x \\ P_y \\ P_z \end{pmatrix}$
- b. scale factor  $\sigma = 1$



**67. What is the use of scale factor?**

Scale factor is used for magnifying or shrinking components of a vector in homogeneous co-ordinates

Representation ( $\sigma > 0$ ) – global scaling

1. ( $\sigma > 1$ ) – for reducing
2. ( $0 < \sigma < 1$ ) for enlarging

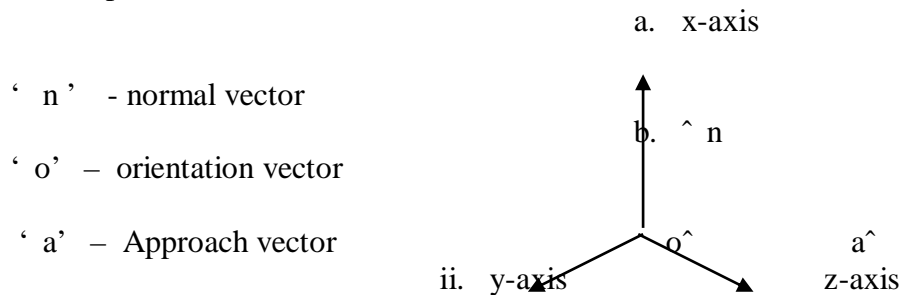
**68. Write homogeneous translation matrix?**

$${}^1P = \begin{pmatrix} 1 & 0 & 0 & dx \\ 0 & 1 & 0 & dy \\ 0 & 0 & 1 & dz \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} {}^2P_u \\ {}^2P_v \\ {}^2P_w \\ 1 \end{pmatrix}$$

a.  ${}^1P = {}^1T_2 {}^2P$

**69. What is orthogonal transformation?**

The vectors ‘ n ’ ‘ o ’ ‘ f ’ ‘ a ’ are in the mutually perpendicular direction and hence the rotation matrix R is called orthogonal transformation because the vectors is the dot product and are all unit vectors.



- ‘ n ’ - normal vector
- ‘ o ’ - orientation vector
- ‘ a ’ - Approach vector

**70. Write homogeneous transformation matrix?**

$$T = \begin{pmatrix} \begin{matrix} \text{i. Rotation matrix} \\ \text{ii. } 3 \times 3 \end{matrix} & \begin{matrix} \text{translation vector} \\ 3 \times 1 \end{matrix} \\ \hline \begin{matrix} \text{iii. Perspective transformation} \\ \text{iv. matrix } 1 \times 3 \end{matrix} & \begin{matrix} \text{scale factor} \\ 1 \times 1 \end{matrix} \end{pmatrix}$$

$${}^1T_2 = \begin{pmatrix} {}^1R_2 \\ 1 & 0 & 0 \end{pmatrix} {}^1D_2$$

**71. What is the use of kinematic model?**

- a. The kinematic model gives relations between What is differential kinematic? the position and orientation of the end effector and spatial positions of joint links.

**72. What is differential kinematic?**

- a. The differential kinematics of manipulators refers to Differential motion that is velocity, acceleration and all higher order derivatives of position variables.

**73. Define Link Length & Link Twist. (or) link parameter ?**

- a. The shortest distance along the common normal is defined as link length and (  $a_i$  )  
the angle between the projection of axis (  $i - 1$  ) and axis  $i$  , on plane perpendicular to the common normal AB , is known as link twist (  $\alpha_i$  )

**74. Write the types of kinematic model?**

direct kinematic model  
Inverse kinematics model

**75. Define direct kinematics?**

Give the set of joint link parameters, the problem of finding the position and orientation of the end effectors w. r to known reference frame for an  $n -$  DOF manipulator is the direct kinematics problem.

**76. Define inverse kinematic?**

- a. For a given position and orientation of the end effector w ith respect to an immobile or inertial reference frame, it is required to find  $n$  set of joint variables that would bring the end effector in the specified position and orientation.

**77. What are DH Parameter?**

(  $\theta_i$  – joint angle,  $d_i$  – joint distance  
 $\alpha_i$  – link angle,  $a_i$  – link length )

**78. Write the homogeneous transformation matrix for represent position and orientation between frame (i) Relative to (i - 1) ?**

$${}^{i-1}T_i = \begin{pmatrix} C\theta_i - S\theta_i C\alpha_i - S\theta_i S\alpha_i & a_i C\theta_i \\ S\theta_i - C\alpha_i C\theta_i - C\theta_i S\alpha_i & a_i S\theta_i \\ 0 - S\alpha_i & - C\alpha_i & d_i \\ 0 - 0 & - 0 & 1 \end{pmatrix}$$

X 3 – orientation of co-ordinate axes of frame  $i$

## UNIT IV

**79. What types of sensors are used in robotics?**

Tactile sensors  
Proximity and range sensors  
Miscellaneous sensors and sensor based system.  
Machine vision system.

**80. What is tactile sensor? Write its types?**

- a. Tactile sensors are devices which indicate contact between themselves and some other solid object.
- b. Types
  1. Force sensors
  2. Touch sensors

**81. What is a force sensor?**

- a. Force sensors are sometimes called stress sensors indicate not only that contact has been made with the object but also the magnitude of the contact force between the two objects. It also applies appropriate level of force for the given parts.

**82. What are the techniques used in force sensors?**

Force sensing wrist.  
Joint sensing  
Tactile array sensors

**83. Write the purpose using force sensing wrist?**

- a. The purpose of using force sensing wrist is to provide information about three components of force ( $F_x$ ,  $F_y$  and  $F_z$ ) and the three moments being applied at the end of the arm.

**84. List out some touch sensors?**

Electrical contact switch  
Limit switch  
Micro switch  
The switches are used to detect the presence or absence of object.

**85. What is a proximity sensor?**

- a. Proximity sensors are located on the wrist or end effectors. It is used to detect the presence or absence of work part or other objects. It senses the human beings in the work cell.
- b. It indicates when an object is close to another object before contact has been made.

**86. Write some of proximity sensors?**

- a. Eddy current detectors, inductive sensors, pyrometers, photometric sensors are some of the proximity sensors.

**87. What is use of strain gauges in sensors system?**

- a. Strain gauges are the transducers which are used to measure force, torque, pressure and other related variables. It is used to indicate force applied to grasp and object.

**88. Write the use of sensors in robotics?**

safety monitoring  
interlocks in work cell control  
part inspection for quality control  
determining positions and related information about objects in the robotic cell.

**89. Write the devices for position and velocity sensors?**

- a. Position sensor – potentiometers, resolvers and encoders
- b. Velocity sensor – DC tachometer.

**90. What is actuators?**

- a. Actuators are the devices which provide the actual motive forces for the robot joints. It yet power from compressed air, pressurized fluid or electricity.

**91. Write the devices for position and velocity sensors?**

- a. Position sensor – potentiometers, resolvers and encoders
- b. velocity sensor – DC tachometer.

**92. What is machine vision?**

- a. A machine vision system is capable of viewing the workspace and interpreting what it sees. These systems are used in robotics to perform inspections, part recognition and other similar tasks.
- b. A machine vision system recovers useful information about a scene from its two dimensional projections. It helps a physician to recover information by enhancing the images.
- c. Vision = Geometry + measurement + Interpretation.

**93. Write the functions of machine vision.**

sensing and digitizing image data.  
Image processing and analysis

**94. What is sensing in machine vision?**

- a. Sensing is the input of vision data by means of camera focused on the scene of interest. Special lightening techniques are frequently used to obtain an image of sufficient contrast.

**95. What is meant by digitizing?**

- a. The image viewed by camera is typically, digitized and stored in computer memory. Converting analog signal to digital signal is called digitizing.

**96. Write types camera used in sensing?**

vidios camera (black & white)      ii) charge couple devices (CCD)  
a. iii) charge injection devices      iv) silicon bipolar sensor  
cameras.

**97. What is pixel?**

- a. The digital image consist of a matrix of data representing projections of the scene sensed by the camera. The element of matrix called pixel. The no. of pixels are determined by a sampling process performed on each frame.

**98. Write two parts of Image formation process?**

The geometry of image formation , which determine where in the image place the projection of a point in the scene will be located.

The physics of light, which determines the brightness of a point in the image place as a function of scene illumination and surface properties.

**99. Write the equation for perspective projection?**

- a.  $X^1/x = f/z$  and  $y^1/y = f/z$  ; Position of point (x, y, z)
- b. f– distance between image place & center of projection.

**100. What is world co-ordinate , model co-ordinates?**

Absolute co-ordinates are also called world co-ordinates.

Individual objects may have their own co-ordinate system called model co-ordinates.

**101. Define sampling and Quantization?**

- a. Image plane & computer must sample the image at a finite number of points and represents each sample with in the finite word size of the computer. This is called sampling & Quantization. Sampling – determine how many pixels the digital image will have,. Quantization – how many intensity levels will be used to represent intensity value at each sample point.

**102. What is an Image?**

- a. Image is a two dimensional array of pixels. The row and column indices (i, j) of n pixel are integer values that specify row & column in the array of pixels.

Index i – point down

- b. j – point to the right

**103. How will you represent pixel co-ordinates in image plane co-ordinates?**

x , y - Image plane co-ordinates.

- a. m , n – pixel array.
- b.  $x = j - (m-1 / 2)$
- c.  $y = - (i - n-1 / 2)$

**104. What is histogram?**

- a. A histogram is a plot of the number of pixel at each gray value contained in the image.

**105. Define object level?**

- a. Properties like size, average intensity, shape and other characteristics of an object must be computed for the system to recognize it of object level.

**106. Define Threshold?**

- a. Threshold is the method to convert a gray scale image in to a binary image so those objects of interest are separated from the background.

**107. Define Region**

Region is a subset of an image.

**108. How will oblation binary image?**

- a. A binary image can be obtained using segmentation of a gray scale image (or) by Thersolding operation.

**109. How will you represent binary image in Thresholding?**

- a.  $F_T [ i , j ] = \begin{cases} 1 & \text{if } F [ i , j ] \geq Z \\ 0 & \text{otherwise} \end{cases}$
- b.  $F_T [ i , j ] = \text{Threshold gray image.}$
- c.  $F [ i , j ] = \text{original gray image}$ 
  - i.  $Z$  – set of intensity values for components.

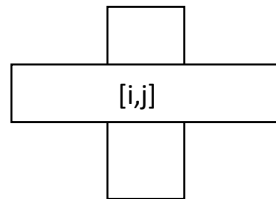
**110. Write the geometric properties to recognize and locate objects?**

- a. Size                      Position                      Orientations are used to recognize the object

**111. Define neighbor?**

- a. A pixel in a digital image is spatially close to several other pixels. The pixel has a common boundary with four pixels and shares a corner with four additional pixels.

**112. Represent 4 neighbors of a pixel [i, j] ?**



- a.  $[i+1 , j]$  ,  $[i-1,j]$  ,  $[i,j+1]$  ,  $[i,j-1]$

**113. Define path?**

- a. A path from the pixel at Initial  $[i_0 , j_0]$  to pixel at the end  $[i_n , j_n]$  is a sequence of pixel Indices  $[i_0 , j_0] \dots [i_n , j_n]$  such that pixel at  $[i_k , j_k]$  neighbour of the pixel at  $[i_{k+1} , j_{k+1}]$  for all  $n$  with  $0 \leq k \leq n - 1$ .

**UNIT V**

**114. Which are the robot programming languages?**

- VAL –II - computer based control system and language designed for the animation industrial robots.
- RAIL - Automatic' s language for CAM
- AML - A manufacturing language.
- AL (Stanford university), MCL, AS , JARS

**115. Write AML statements?**

- Executable statement
- Variable declaration statement
- Subroutine declaration statement
- In AML all the statements ended with semicolon (I)

**116. What is meant by constants and variables in robot languages?**

- Constant is a value used in the program that does not change during the execution of the program.
- A variable is symbol or symbolic name that can change in value during execution of program.

Constants and variables can be integers, real numbers containing a decimal point, or strings that are enclosed in quotes.

**117. Write some important language elements in robot?**

- a. 1. Constant variables and other objects      2. motion command
- b. 3. End effectors and sensor commands      4. Computations and operations.
- c. 5. Program control and subroutines      6. Communication and data processing
- d. 7. Monitor mode commands

**118. In robot language write motion commands which control the movement of the manipulator arm.**

- a. Move, A1  
Move- causes the end of the arm to move from its present position to the point name A1 by interpolation motion.
- b. A1 – defines the position and orientation of the end effectors  
MOVE A1 via A2  
c. Similar to previous one but via A2 refers intermediate point.  
APPRO A1, 50  
d. APPRO command causes the end effectors to be moved to the vicinity of point A1, but offset from the point along the tool z axis in the negative direction by a distance of 50 mm.  
DEPART 50, statement  
e. Causes the robot to move away from the pickup point along the tool z axis to a distance of 50mm.

**119. What are the two types of arc welding used in robots?**

- gas metal arc welding (GMAW) – used for weld wires.
- Gas tungsten arc welding (GTAW) – welding aluminium, copper and stainless steel.

**120. Write the features to be considered in welding robot?**

- work volume and DOF
- motion control system
- Interface with other system.
- Programming

**121. Write the type of sensor used in arc welding?**

- Contact welding sensors.
- Non contact arc welding sensors.

**122. Write the advantage of using robots in spray coat?**

- a. Fumes and mist in the Air can be controlled.
- b. Noise from nozzle reduced.
- c. Fire hazards can be avoided.
- d. Potential cancer hazards can be reduced.

**123. Give some components which can use robot spray coating?**

- painting of car bodies, engines, and other components in the automotive industry.
- Spraying of prints and sound absorbing coatings on appliances.
- Application of porcelain coatings in bathroom fixtures.

Spray staining of wood products.

**124. Why robots used in CIM environment?**

Robots are used in CIM environment because of they have a number of economic and performance advantage over human labour or hard automation on manufacturing application, particularly in batch manufacturing. Robots have reprogram ability.

**125. What are the two types of arc welding used in robots?**

Gas metal arc welding (GMAW) – used for welded wires.

Gas tungsten arc welding (GTAW) – welding aluminium , copper and stainless steel.

**126. Write the features to be considered in welding robot?**

Work volume and DOF

Motion control system

Interface with other system.

Programming

**127. Write the type of sensor used in arc welding?**

Contact welding sensors.

Non contact arc welding sensors.

**128. Write in application of industrial robot?**

- i. Material handling
- ii. Operation
- iii. Assembly operation
- iv Inspection

**129. List out some of the task that robot cando better?**

Handling dangerous materials

Assembly products

Spray finishing

Polishing and cutting

Inspection

Repetitive, backbreaking and unrewarding tasks

Task involving danger to humans or dangerous task.

**130. Write the reasons why robots are used instead of human being?**

Time consuming

Does not tire

Does not seek or obtain wage increases and fringe benefits, such as paid holidays and vacations.

Does not go out on strike or slow down due to disagreements

Does not argue or debate the supervision ideas.

**131. What are the advantages of using robots in industries?**

Reduced labour costs

Improved product quality

Elimination of dangerous jobs.

Increased output rate.

Increases product flexibility

Reduced materials waste

Reduced labour turn over.

Reduced capital cost



**132. List out some non – industrial application of robots.**

Home sector like sweeping and cleaning, cooking, entertainment, garden maintenance.

Health care like patient care and monitoring surgery etc.

Service sector like traffic control, fire lighting drive a vehicle, manage shopping halls etc.

Agriculture and farms - like plough fields, sow seeds and transplant sapling, pluck sort and pack fruits, animal shearing

**133. Write the future application of robots.**

Space exploration

Under sea exploration

Nuclear research

Geological exploration

**134. How will you evaluate for a particular application with use of robot?**

To evaluate the use of robot for a particular application a check list is given

The check list is based on factors such as application requirement such as monotonous / repetitive operation

medium complex operation

no complex judgment or decision making required

need to position and orient part or tool and physical environment

Work station is well organized, hazardous environment; machine in work station can receive parts automatically etc.

**135. What are the significant costs involved in deployment of robot?**

Cost involved are

Robot and its peripherals

Tooling and installation

Layout changes

Equipment modification

Maintenance

Safety equipment

Training

Applications engineering

**136. What are the four basic principles for robot applications in industries?**

If the conditions at the work place repeat without significant unstructured variability then a simple robotics solution is possible

If the work cycle changes often but within the limits, robotics solutions are possible due to reprogram ability of the robots.

For all changes that are imposed due to a robot installation the robot behaviour and the work place must be capable of change

Recognize and exploit or create robot compatible mechanical states or environments and eliminate or reduce the need for human skill and judgement.

**137. What are the factors considered when planning for a robot application to perform task in industry?**

- workplace analysis and evolution
- recognition of requirements of alternative methods for automation
- selection of optimal method

- search for solutions to implement the selected methods
- economic analysis

**138. Give some example where non-servo type & servo type robots are used?**

- Non-servo type robots are used for simple operation like transferring the parts.
- Servo controlled point to point robots are used to perform complicated task like machine tool loading and unloading, palletizing the parts for the machine centre, in fms or sorting the parts.
- Servo controlled continuous path robots are used in welding, finishing, maintenance & assembly etc.

**139. What is meant by flexible assembly in industries?**

Flexibility refers to the systems ability to accept variation in different modes of the assembly tasks accommodating the design characteristics of the components and product variations with out any considerable change in the tooling. It includes versatility and adaptability to cope with the new demand.

**140. Write the process of robot programming?**

The process of robot programming involved “ teaching” if the task to be performed, storing the program, executing the program, and debugging it.

**141. What is world co-ordinate system in robots?**

This method called x, y and z co-ordinate system allows the wrist location to be defined using the conventional Cartesian co-ordinate system with origin at some location in the body of the robot.

**142. What is meant by tool co-ordinate system?**

This is a Cartesian co-ordinate system in which the origin is located at some point on the wrist and x y plane is oriented parallel to the face plate of the wrist .Accordingly z-axis is perpendicular to the face plate and pointing in the same direction as a tool or other end effectors attached to the face plate.

**143. Write fever interpolation schemes which are specified by the robot?**

joint interpolation  
 straight line interpolation  
 circular interpolation  
 irregular smooth motion

**144. What is meant by joint interpolation?**

The controller determines how for each joint must move to get from the first point defined in the program to the next. It then selects the joint that requires the longest time. This determines the time it will take to complete the move. Based on the known time and the amount of the movement required for the other axes, the controller subdivides the move into smaller increments so that all joints start and stop motions at the same time.

**145. What is meant by straight line interpolation?**

The robot controller computes the straight line path between two points and develops the sequence of addressable points along the path for the robot to pass through.

**146. What is meant circular interpolation?**

Circular interpolation is the linear approximation of the circle, in which the programmer has to define a circle in the robot's workspace. This is done by specifying three points that lie along the circle. The controller then constructs an approximation of the circle by selecting a series of addressable points that lie close to the defined circle.

- 147. What are the three basic modes of operation for robot language operating system.**  
Monitor mode – used to accomplish overall supervisory control of the system.  
Run mode - for executing robot program.  
Edit mode - provides an instruction set that allows the user to write new programs or to edit existing programs.
- 148. What is an aggregate in robot language?**  
An aggregate is an ordered set of constant or variables. It is used to specify the joint coordinate values of robot's joints.
- 149. What are the different sensing elements for pneumatics sensors ?**  
Limit valves, back pressure, proximity sensors, gap sensors, limit switch.
- 150. State the reasons for using robots in industries.**  
Better quality of the product.  
Elimination of hazardous tasks. , Improved productivity. Reduced costs.
- 151. Enlist the basic components of a robotics arc welding system.**  
Power source. The welding gun, gas supply unit, controller, terminal, input and output modules, wire feed units, root main body Teach box.
- 152. List the applications of automation ?**  
Numerical control, automated production line. Automated assembly. robotics in manufacturing. Flexible manufacturing systems. Building automation systems.

## **PART B □ QUESTIONS**

1. Explain with neat sketch, the Robot configurations.
2. Explain different types of drive system in Robots?
3. Explain the PTP and CPC controls in Robots.'
4. With the neat sketch explain the degrees of freedom associated with robot wrist.
5. Explain with the neat sketch, several type of joints used in robots.
6. Explain with neat sketch, different types of joints & links in robotics?
7. Describe the functions of four basic component of a robot?
8. What are the advantages of disadvantages between polar arm and articulated arm?
9. What are the advantages of disadvantages between cylindrical arm and Cartesian arm?
10. Explain control system analysis?
11. Explain in detail feedback devices in robots?.
12. Write in detail the type of actuator used in Robot?
13. Explain in detail robot arm dynamics?
14. Explain gripper mechanism – in detail.
15. Explain the working of vacuum up gripper?
16. Explain in detail the working of magnetic grippers write in advantages & disadvantages.

17. Explain hooks, scoop of gripper?
18. Explain tools on end effectors with example?
19. Explain in detail Robot/ end effectors interface?
20. Explain step by step procedure direct kinematics?
21. Make a list of internal state sensors used in robotic manipulators. Give brief description of their working and use.
22. Give situations where robot will require non contact sensors. Identify suitable non contact sensors for these applications and explain their working.
23. Briefly describe the working of some contact sensors used in robotics. Give advantages and disadvantages of each.
24. What tasks can be performed by a robotic vision system? Briefly explain.
25. Compile a list of sensors that might be used in robotic systems. For each sensor, give an application.
26. Tabulate the advantages and disadvantages of different sensors, which can be used to obtain controlling information in robotic systems.
27. Discuss the industrial and non industrial applications of vision controlled robot.
28. Show how an image storage requirement depends on spatial and amplitude digitization parameters.
29. Explain Goals of AI Research?
30. What are different techniques used for knowledge representation?
31. Explain the methods used for problem representation?
32. Explain in detail search Techniques in problems solving.
33. Explain in detail Teach pendant functions.
34. Explain the Robot programming language VAL – II
35. Explain the Robot programming language RAIL
36. Explain the Robot programming language AML
37. Write the different between lead through method & Textual languages.
38. Explain in detail what is motion interpolation?
39. Write the capabilities & limitation of lead through methods.
40. Cylindrical work pieces are to be picked up and inserted in the lathe chuck. Suggest type of robot and the end – effect to grip and insert the work pieces.
41. What are the added advantages of using three fingered grippers over two fingered grippers?
42. What are the possible robot applications in manufacturing industries? Classify such robots from the viewpoints of drives and control.
43. What is assembly? Distinguish between an automatic assembly and a flexible assembly.
44. What are the basic rules and procedures followed in the use of robot in assembly?
45. Why are SCARA robots preferred for assembly operations? Compare and contrast Revolute robots and Scara robots from the viewpoint of assembly operations.
46. What are the steps necessary for robotic arc welding?
47. What is spot welding? Describe briefly the operations involved in robotic spot welding. What are the advantages of robotic welding over manual welding?
48. How does spray painting work? Describe a spray painting booth for painting automobile cars using a suitable spray painting robot.
49. What type of manipulator is generally used in welding applications/
50. What characteristics an arc – welding robotic system must have?
51. What are essential characteristics of a spot welding manipulator?