UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA

SECOND SEMESTER EXAMINATIONS, MAY 2019

COURSE NO: CE/EL 464
COURSE NAME: INTRODUCTION TO ROBOTICS
CLASS: CE/EL IV **TIME:** 3 HOURS

Name**:** _____Index Number: _____

Section A: For each of the following questions, choose the correct option from the list of alternatives provided

1. What is the name for information sent from robot sensors to robot controllers?
   a. Temperature
   b. Pressure
   c. Feedback
   d. Signal
2. Which one of the following terms refers to the up - down motion of a robot arm?
   a. Yaw
   b. Pitch
   c. Lateral
   d. Roll
3. What is the name for the space inside which a robot unit operates?
   a. Environment
   b. Spatial space
   c. Work envelop
   d. Exclusion zone
4. Which of the following terms IS NOT one of the five basic parts of a robot?
   a. Peripheral tools
   b. Controller
   c. Sensor
   d. Drive
5. The number of moveable joints in the base, the arm, and the end effector of the robot determines .....?
   a. Degrees of freedom
   b. Payload capacity
   c. Operational limit
   d. Flexibility
6. Which of the following places would be LEAST likely to include operational robots?
   a. Warehouse
   b. Factory
   c. Hospital
   d. Private homes
7. For a robot unit to be considered a functional industrial robot, typically, how many degrees of freedom would the robot have?
   a. Three
   b. Four
   c. Six
   d. Eight
8. Which of the basic parts of a robot unit would include the computer circuitry that could be programmed to determine what the robot would do?

a. Sensor
b. Controller
c. Arm
d. End effector

9. With regard to the physics of power systems used operate robots, which statement or statements is most correct?

a. hydraulics involves the compression of liquids
b. hydraulics involves the compression of air
c. pneumatics involve the compression of air
d. chemical batteries produce AC power

10. Which of the following statements concerning implementation of robotic systems is correct?

a. implementation of robots CAN create new jobs
b. robotics could prevent business from closing
c. all of the above are possible
d. Only *b* and *c* are possible

11. Which of the following IS NOT one of the advantages associated with a robotics implementation program?

a. Low costs for hardware and software
b. Robots work continuously around the clock
c. Quality of manufactured goods can be improved
d. Reduced company cost for worker fringe benefits

12. Which of the following "laws" is Azimov's first and most important law of robotics?

a. robot actions must never result in damage to the robot
b. robots must never take actions harmful to humans
c. robots must follow direction given by humans
d. robots must make business a greater profit

13. A manipulator is also known as

a. Track drive
b. Robot arm
c. Vision system
d. Controller

14. Proximity sensing is mostly akin to

a. Direction movement
b. Epipolar movement
c. Distance measurement
d. Machine vision

15. Spherical coordinates can uniquely define the position of a point up to …. dimensions.

a. one
b. two
c. three
d. four

16. The region throughout which a robot can accomplish tasks is called

a. Coordinate geometry
b. Reference axis
c. Degree of freedom
d. Work envelope

17. If a robot can alter its own trajectory in response to external conditions, it is considered to be

a. Intelligent
b. mobile
c. open loop
d. non-servo

18. Radial movement (in & out) to the manipulator arm is provided by

a. Elbow extension
b. Wrist swivel
c. Wrist bend
d. Wrist yaw

19. Industrial robots are generally designed to carry which of the following coordinate system(s)?

a. Cartesian coordinate systems
b. Polar coordinate systems
c. Cylindrical coordinate systems
d. All the above

20. Drives are also known as

a. Actuators
b. Sensors
c. Controllers
d. Manipulators

21. The Robot designed with Polar coordinate systems has

a. Three linear movements
b. Three rotational movements
c. Two linear and one rotational movement
d. Two rotational and one linear movement

22. Which of the following work is done by General purpose robot?

a. Part picking
b. Welding
c. Spray painting
d. All of the above

23. The following drive is used for lighter class of robot.

a. Position
b. Position & Velocity
c. Position & Acceleration
d. Position, velocity and acceleration

24. Which of the following sensors determines the relationship of the robot and its environment and the objects handled by it

a. Internal State sensors
b. External State sensors
c. Both (A) and (B)
d. None of the above

25. In which of the following operations Continuous Path System is used?

a. Pick and Place
b. Loading and Unloading
c. Continuous welding
d. All of the above

26. A robot is considered to be ------ if it capable of altering its own trajectory.

a. Mobile
b. Intelligent
c. Closed loop
d. Open loop

27. A relay is a type of

a. Actuator
b. Sensor
c. Controller
d. End effector

28. The type of control used in Bang-bang robot is called
a. Servo
b. Non-servo
c. All the above
d. None of the above

29. SCARA robots are used in -------- application.
a. quality control
b. assembly
c. defense
d. all the above

30. The attractive feature of SCARA robot is
a. repeatability
b. accuracy
c. selective compliance
d. more tolerance

31. Preferred robot system for load carrying applications
a. hydraulic
b. pneumatic
c. electrical
d. mechanical

32. Type of drive used for larger robots
a. hydraulic
b. mechanical
c. pneumatic
d. electrical

33. Type of robot used in spot-welding applications is called
a. Point-to-point
b. Sequential
c. End point
d. Continuous path

34. Which of the following is not the functionality of Robot?
a. Reprogramability
b. Multifunctionality
c. Responsibility
d. Efficient performance

35. Which part of a robot provides motion to the manipulator and end-effectors?
a. Controller
b. Actuator
c. Sensor
d. All the above

36. Which of the following is not the type of actuator?
a. Digital Actuator
b. Pneumatic Actuator
c. Hydraulic and eclectic actuator
d. None of the above

37. The kinematic part of the robot or manipulator is called
a. Link
b. Joint
c. End effector
d. None of the above

38. In a robot the ‘Translatory Joints’ known as

a. Revolute
b. Prismatic
c. Cylindrical
d. Spherical

39. Piston-cylinder arrangement of an internal combustion engine in automobile is called
a. Rotary Joints
b. Prismatic Joints
c. Revolute Joints
d. Spherical Joints

40. The Robot designed with cylindrical coordinate systems has
a. three linear movements
b. three rotational movements
c. two linear and one rotational movement
d. two rotational and one linear movement

Section B: ***Using T or F respectively, state whether the following statements are True or False***

41. The Zeroth Law of robotics states that: A robot must protect its own existence except where it is told by a human to terminate its existence.

42. Robots are used extensively in exploration both on Earth and in outer space.

43. Both contact and non-contact sensors are proximity sensors

44. Spur gears are a type of compound gears having two or more gears on the same shaft.

45. Cylindrical robots can reach above themselves

46. Idler gears consist of sprockets which have teeth designed to fit into the links.

47. Spherical robots have 3P type configuration.

48. Smaller resolutions are better are reading positional information in optical encoders.

49. The optical encoder is an example of exteroceptive sensors.

50. A reduction mechanism such as gear box decreases the measurement resolution of joint angles by a factor depending on the gear ratio.

Section C: ***Fill-in the spaces provided with correct answers***

51. The working principle of the laser range finders is……...

52. …….. is a device that depend on the earth's gravity to determine orientation of objects.

53. …….. is the term used to describe the ratio of the number of teeth per pitch diameter.

54. …….. are extra gears added to a system to change the direction of rotation on a dedicated shaft.

55. Chain-driven systems use …… which have teeth designed to fit into the links of the chain.

56. Internal state sensors are also known as ……..

57. An …… is a measure of rotational angle of robot motor shaft.

58. ……... problem is a phenomenon in which a robot equipped with more than one ultra-sonic sensor experience misdirected and intersecting signals.

59. A force-sensitive resistor is an example of a ……. whose principle of operation is governed by change in resistance with respect to force.

60. …….. systems consist of a spur gear and a rod or bar that has teeth cut along the length.

Section D*: Attempt ALL question in this section*

1. a) State and explain the function of any five components of an industrial robot.

   b) State the four required characteristics of a robot.

   c) State and explain the 4As and 4Ds of a robotic system.

2. a) Mention any four robotic configurations, and for each clearly state the following

   i. Nature of degrees of freedom

   ii. Work envelope

   iii. An advantage and a disadvantage

b) Distinguish between servo and non-servo-controlled robots.

c) Briefly explain the three hierarchical levels of control in robotic systems.

3. a) In relation to belt-driven systems, define the following

   i. Torque

   ii. Pulley ratio

   iii. Velocity

   iv. Power

   b) Distinguish between the principle of operation between IR range sensors and Ultrasonic sensors, categorically stating any two limitations of each.

   c) Define direct drive systems and state any three advantages of these systems.

Examiner: Dr Hamidu Abdel-Fatao