# ROBOTICS END SEMESTER MAKE-UP EXAMINATION (FEBRUARY 2022)

**COURSE CODE : ROBOTICS**
**COURSE NAME : ICE 4068**
**SEMESTER : VII**
**DATE OF EXAM : 22/02/2022**
**DURATION : 45 + 3 minutes**

***Instructions for Students:***
*(1) ANSWER ALL THE QUESTIONS.*
*(2) EACH QUESTION CARRIES 1 MARK.*
*(3) YOU ARE INSTRUCTED TO INFORM THE INVIGILATOR AFTER SUBMISSION OF THIS FORM IN THE CHAT SECTION.*

* Required

* This form will record your name, please fill your name.

1. STUDENT NAME: *

2. REGISTRATION NUMBER: *

3. Law zero of robotics states that (1 Point)

- A robot must protect its own existence as long as such protection does not conflict with a higher order law.
- A robot must obey orders given it by human beings, except where such orders would conflict with a higher order law.
- A robot may not injure a human being, or, through inaction, allow a human being to come to harm, unless this would violate a higher order law.
- A robot may not injure humanity, or, through inaction, allow humanity to come to harm.

4. The first robot was built in (1 Point)

- 1495
- 1498
- 1492
- 1496

5. The joints in the kinematic chain of a robot between the forearm and end-effector are referred to as (1 Point)

- actuator
- wrist
- link
- manipulator

6. "The most general displacement of a rigid body with one point fixed is a rotation about some axis" is statement from the (1 Point)

- ◯ Chasles's theorem
- ◯ Euler's theorem
- ◯ Newton's theorem
- ◯ Lagrange's theorem

7. Robot control does not comprise of which of the following statements? (1 Point)

- ◯ Determination of the trajectory in Cartesian coordinate space
- ◯ Study of systems that undergo changes of state as time evolves
- ◯ Transformation of the Cartesian trajectory into equivalent joint coordinate space
- ◯ Generation of the motor torque commands to realize the trajectory

8. The homogeneous coordinates of a position vector are the same as physical coordinates of the vector and the space is the standard Euclidean space if the cale factor 'w' is (1 Point)

- ◯ 0
- ◯ 1
- ◯ infinity
- ◯ -1

9. Which of the following statement is false? (1 Point)

- Decomposition of a transformation to translation and rotation is not interchangeable.
- It is possible and sometimes convenient to describe a rigid body motion in terms of known displacement of specified points fixed in the body.
- A transformation can be achieved by a pure translation first followed by a pure rotation.
- A transformation can be achieved by a pure rotation first followed by a pure translation.

10. Derivative control is used (1 Point)

- to eliminate the steady state error and make the system follow the set point at steady state conditions
- to improve the closed-loop stability of a system
- to provide bias
- control uncertainties

11. A point sequence path with seven conditions for the sequence of points has (1 Point)

- 9 coefficients
- 6 coefficients
- 7 coefficients
- 8 coefficients

12. The distance between xi−1 and xi axes along the zi-1 axis is: (1 Point)

- ◯ Link twist
- ◯ Joint distance
- ◯ Joint angle
- ◯ Link length

13. A playback robot comes under the following class: (1 Point)

- ◯ 5
- ◯ 3
- ◯ 4
- ◯ 6

14. The configuration of the SCARA arm is (1 Point)

- ◯ R∥R∥P
- ◯ R∥R⊥P
- ◯ R⊥R⊥R
- ◯ R⊢R⊥R

15. A body coordinate frame, B, undergoes three Euler rotations (ϕ, θ, ψ) = (30, 45, 60) deg with respect to a global frame G. The unique angle-axis of rotation is: (1 Point)

- ◯ [0.48822 0.13082 0.86285]
- ◯ [0.48822 -0.13082 0.86285]
- ◯ [0.48822 0.13082 -0.86285]
- ◯ [-0.48822 0.12082 0.86285]

16. Point P of a rigid body B has an initial position vector . If the body rotates 45 deg about the x-axis, and then translates to , the final position of P is: (1 Point)

- ◯ [5 4.23 -9.53]
- ◯ [5 -4.23 9.53]
- ◯ [5 4.23 9.53]
- ◯ [-5 4.23 9.53]

17. A point P is located at (0, 0, 200) in a body coordinate frame. If the rigid body rotates 30 deg about the global X-axis and the origin of the body frame translates to (X, Y, Z) = (500, 0, 600), What are the coordinates of the point in the global frame? (1 Point)

- ◯ [500 100 773.2 1]
- ◯ [500 -100 773.2 1]
- ◯ [-500 100 773.2 1]
- ◯ [500 100 -773.2 1]

18. The matrix for pure translation about the x-axis by a factor 'a' is (1 Point)

- [1 0 0 a;0 1 0 0;0 0 1 0;0 0 0 1]
- [1 0 0 0;0 1 0 0;0 0 1 a;0 0 0 1]
- [1 0 0 0;0 1 0 a;0 0 1 0;0 0 0 1]
- [1 0 0 0;0 1 0 0;0 0 1 0;a 0 0 1]

19. When the proximal joint of link (i) is prismatic and the distal joint is either revolute or prismatic, and the joint axes at two ends are parallel, then: (1 Point)

- Joint distance is constant
- Link twist=90 deg
- Lin length is constant
- Joint angle=90 deg

20. According to the D-H method, if the first and last joints are prismatic, then which of the following statements are true: (1 Point)

- Both the joint angle of base and end-effector are not equal to 0 deg
- Only the joint angle of end-effector=0 deg
- Only the joint angle of base=0 deg
- Both the joint angle of base and end-effector=0 deg

21. Dot product of the following two vectors is:

    vector a=2i+3j+4k, vector b=2i+1j+6k (1 Point)

- ◯ 32
- ◯ 34
- ◯ 33
- ◯ 31

22. The sequence of performing rotations is very important because: (1 Point)

- ◯ Matrix multiplications do not commute
- ◯ Matrix multiplications involve orthogonal vectors
- ◯ Matrices are direction cosines of the vectors
- ◯ Matrix multiplications depend on the axes of rotations

23. A point P was at [1 2 z]. After a rotation of 60 deg about X-axis it is at [X Y 2.933]. The 'z' value of point P before rotation was: (1 Point)

- ◯ 1.402
- ◯ 2.503
- ◯ 2.402
- ◯ 2

24. Which of the following terms refers to the use of compressed gasses to drive the robot device? (1 Point)

- ◯ piezoelectric
- ◯ pneumatic
- ◯ hydraulic
- ◯ polymeric

25. If the coordinates of a point P in the body/local reference frame is [1 -1 2 1] is translated to a point P in the global reference frame with coordinates [-1 8 4 1], the transformation matrix is: (1 Point)

- ◯ [1 0 0 2;0 1 0 7;0 0 1 5;0 0 0 1]
- ◯ [1 0 0 -1;0 1 0 8;0 0 1 3;0 0 0 1]
- ◯ [1 0 0 3;0 1 0 9;0 0 1 4;0 0 0 1]
- ◯ [1 0 0 -2;0 1 0 9;0 0 1 2;0 0 0 1]

26. Forcing a variable to have specific position, velocity, and acceleration at boundaries introduces six conditions, so the degree of the polynomial to satisfy these conditions must be:
(1 Point)

- ◯ 7
- ◯ 4
- ◯ 6
- ◯ 5

27. Lagrange's Form of Newton's Equations relates (1 Point)

- Kinetic energy with nonpotential generalized force
- Potential energy with generalized force
- Potential energy with nonpotential generalized force
- Kinetic energy with generalized force

28. Forward velocity kinematics of a robot solves the problem of relating (1 Point)

- joint distances to the end-effector speeds
- joint speeds to the end-effector speeds
- link lengths to the end-effector speeds
- link speeds to the end-effector speeds

29. In robot statics analysis (1 Point)

- The reaction force system can be calculated when the action force system is given
- The action force can be calculated when the reaction force is given.
- The reaction force can be calculated when the action force is given.
- The action force system can be calculated when the reaction force system is given

30. The diagonal elements of the inertia matrix are called (1 Point)

- ◯ polar moments of inertia
- ◯ products of inertia
- ◯ centrifugal moments
- ◯ deviation moments

31. Solving to find principal axes and principal moments of inertia leads to a (1 Point)

- ◯ cubic equation
- ◯ quadratic equation
- ◯ quintic equation
- ◯ quadratic equation

32. The technique for controlling uncertain or time-varying robots is: (1 Point)

- ◯ Gain-Scheduling Control Technique
- ◯ Computed Torque Control Technique
- ◯ Linear Control Technique
- ◯ Adaptive Control Technique