END SEMESTER EXAMINATIONS (DECEMBER 2021/JANUARY 2022) - QUESTION PAPER - PART A

COURSE CODE : ICE-4068
COURSE NAME : Robotics
SEMESTER : VII
DATE OF EXAM : 22/12/2021
DURATION : 45 + 5 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: *

The value must be a number

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

- ◯ Only the link length of the end-effector=0
- ◯ Only the link length of the base=0
- ◯ Both the link length of the base and end-effector are not equal to 0
- ◯ Both the link length of the base and end-effector=0

4. The axis of rotation for the following transformation matrix is:

R=[0.75 0.6124 0.25;-0.6124 0.5 0.6124;0.25 -0.6124 0.75]
(1 Point)

- ◯ u=[0.5 0 -0.5]
- ◯ u=[-0.5 0 0.5]
- ◯ u=[0.7071 0 -0.7071]
- ◯ u=[-0.7071 0 0.7071]

5. Integral control is used
(1 Point)

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

6. Singular configurations happen when:
(1 Point)

- ◯ Two axes of prismatic joints become identical
- ◯ Two axes of prismatic joints become parallel
- ◯ Two axes of prismatic joints become perpendicular
- ◯ Two axes of prismatic joints become orthogonal

7. Feedback Linearization or Computed Torque Control Technique is
(1 Point)

- ◯ more suitable for low DOF robots
- ◯ for controlling uncertain or time-varying models
- ◯ linear control technique
- ◯ model-based control method

8. The angle of rotation for the following transformation matrix is:

R=[0.75 0.6124 0.25;-0.6124 0.5 0.6124;0.25 -0.6124 0.75]
(1 Point)

- ◯ 30
- ◯ 75
- ◯ 60
- ◯ 45

9. Every kinematic information must be calculated in the:
(1 Point)

- ◯ World frame
- ◯ Body frame
- ◯ Base frame
- ◯ End-effector frame

10. To calculate the path of motion for the end-effector:
(1 Point)

- ◯ the joint variables as functions of time, and the forward kinematics of manipulators are required
- ◯ the link variables as functions of time, and the inverse kinematics of manipulators are required
- ◯ the joint variables as functions of time, and the inverse kinematics of manipulators are required
- ◯ the link variables as functions of time, and the forward kinematics of manipulators are required

11. A rotational path is defined by
(1 Point)

- ◯ angle-axis rotation matrix
- ◯ transformation matrix
- ◯ direction cosine matrix
- ◯ quaternions

12. **The degree of freedom of a manipulator is determined by the**
(1 Point)

- ◯ Number of axes of the manipulator
- ◯ Number of links of a manipulator
- ◯ Number of joints of a manipulator
- ◯ Number of frames of a manipulator

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

- ◯ 3
- ◯ 2
- ◯ 4
- ◯ 5

14. Consider an inertia matrix given by: [3 2 2; 2 2 0; 2 0 4], the direction of principal axis xi is:
(1 Point)

- ◯ 69.3 deg, 90 deg, 90 deg
- ◯ 45 deg, 69.3 deg, 45 deg
- ◯ 90 deg, 90 deg, 69.3 deg
- ◯ 45 deg, 45 deg, 69.3 deg

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

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

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

- Link twist=90 deg
- Joint distance is varying
- Joint angle is constant
- Link length=0

17. Conservative force is derivable from
(1 Point)

- Kinetic energy
- Potential energy
- Moment
- Torque

18. The off-diagonal elements of a moment of inertia matrix are called:
(1 Point)

- ◯ Principal moments of inertia
- ◯ Polar moments of inertia
- ◯ Deviation moments of inertia
- ◯ Products of inertia

19. A mass m = 4kg has an initial kinetic energy K = 16J. The mass is under a constant force F=1i+0j+0k and moves from X(0)=1 to X(tf)=25 m at a terminal time tf. What is the kinetic energy of the mass?
(1 Point)

- ◯ 16 J
- ◯ 30 J
- ◯ 20 J
- ◯ 40 J

20. The configuration of an articulated arm is
(1 Point)

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

21. The second law of rotational motions states that:
(1 Point)

- ◯ the global rate of change of angular momentum is proportional to the global applied force
- ◯ the global rate of change of linear momentum is proportional to the global applied moment
- ◯ the global rate of change of linear momentum is proportional to the global applied force
- ◯ the global rate of change of angular momentum is proportional to the global applied moment

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

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

23. Consider an inertia matrix given by: [3 2 2; 2 2 0; 2 0 4], the principal moments of inertia are:
(1 Point)

- ◯ 6,3,0
- ◯ 3,0,6
- ◯ 6,0,3
- ◯ 3,6,0

24. Acceleration sensors work based on
(1 Point)

- Newton-Euler's equation of motion
- Newton's first law of motion
- Newton's second law of motion
- Newton's third law of motion

25. The moment of momentum is also called
(1 Point)

- linear momentum
- angular momentum
- translational momentum
- torque

26. Path planning includes
(1 Point)

- Defining a geometric curve for the end-effector between two points
- Defining a geometric curve for the base between two points
- Defining a coordinate between two given values
- Defining a translational motion between two orientations

27. Increasing the control command when the actual variable is smaller than the desired value and
decreasing the control command when the actual variable is larger than the desired value is:
(1 Point)

- ◯ feedback control
- ◯ feed-forward control
- ◯ open loop control
- ◯ non-linear control

28. If a body point at [-1 ;0; 2 ; 1] is translated to [0; 10; -5; 1] , the corresponding transformation matrix is:
(1 Point)

- ◯ [1 0 0 -1;0 1 0 10;0 0 1 -7;0 0 0 1]
- ◯ [1 0 0 1;0 1 0 10;0 0 -1 -5;0 0 0 1]
- ◯ [1 0 0 1;0 1 0 10;0 0 1 -5;0 0 0 1]
- ◯ [1 0 0 1;0 1 0 10;0 0 1 -7;0 0 0 1]

29. A mass m = 4kg has an initial kinetic energy K = 16J. The mass is under a constant force F=1i+0j+0k and moves from X(0)=1 to X(tf)=25 m at a terminal time tf. What is the terminal speed of the mass?
(1 Point)

- ◯ 1.4142 m/s
- ◯ 4.4721 m/s
- ◯ 2.2361 m/s
- ◯ 3.1623 m/s

30. A mass m = 4kg has an initial kinetic energy K = 16J. The mass is under a constant force F=1i+0j+0k and moves from X(0)=1 to X(tf)=25 m at a terminal time tf. What is the work done by the force during this motion?
(1 Point)

- ◯ 22 J
- ◯ 25 J
- ◯ 23 J
- ◯ 24 J

31. Forcing a variable to have specific position, velocity as initial and final conditions leads to a polynomial path with degree
(1 Point)

- ◯ 4
- ◯ 5
- ◯ 2
- ◯ 3

32. A link Jacobian transforms
(1 Point)

- ◯ the instantaneous joint angles into the instantaneous link's translational and angular velocities.
- ◯ the instantaneous link coordinate velocities into the instantaneous link's translational and angular velocities.
- ◯ the instantaneous joint coordinate velocities into the instantaneous link's translational and angular velocities.
- ◯ the instantaneous link twists into the instantaneous link's translational and angular velocities.