Week 11 - Assignment 11

The due date for submitting this assignment has passed. Due on 2021-04-07, 23:59 IST.

As per our records you have not submitted this assignment.

Instructions:

- If not explained all symbols have same meaning as in the lectures.
- Use the D-H convention followed in the course wherever mentioned.
- In some options to the MCQ/MSQ the text may not be adjacent to checkbox (circle or square). Consider the text just below it for such cases.

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1) A wheel rolling without slip on a plane

- [ ] can have motion only along the tangent to the path.
- [ ] can have motion perpendicular to the path.
- [ ] is described with three generalised coordinates
- [ ] is described with three generalised coordinates but contain only two degrees of freedom in velocities.

No, the answer is incorrect.
Score: 0
Accepted Answers: can have motion only along the tangent to the path.

2) A wheel on a flat surface can only move

- [ ] if there is friction at the wheel ground contact point.
- [ ] if there is deformation at the wheel ground contact point.
- [ ] if a tractive force is developed at the wheel ground contact point.

2 points
3) The motion of a bicycle moving on a flat ground
   - can be described by four generalized coordinates and no constraints.
   - can be described by four generalized coordinates but there are two constraints in each wheel.
   - can be described by four generalized coordinates but there are non-holonomic two constraints at the two wheels.
   - can be thought of as a rotation about the instantaneous centre.

   No, the answer is incorrect.
   Score: 0
   Accepted Answers:
   - can be described by four generalized coordinates but there are non-holonomic two constraints at the two wheels.
   - can be thought of as a rotation about the instantaneous centre.

4) In a three-wheeled tricycle with front wheel steered and moving without slip
   - the speeds of the two rear wheels can be arbitrary
   - only one of the rear wheels can be driven.
   - the speed of the two rear wheels must be such that there is a single instantaneous centre.
   - the speeds of the two rear wheels must be such that there are two instantaneous centres.

   No, the answer is incorrect.
   Score: 0
   Accepted Answers:
   - only one of the rear wheels can be driven.
   - the speed of the two rear wheels must be such that there is a single instantaneous centre.

5) The Ackerman steering in a car is used
   - to steer a car sharply along a curve in the road.
   - to steer a car avoiding slip.
   - to steer a car avoiding vibration.
   - to steer a car without losing speed.

   No, the answer is incorrect.
   Score: 0
   Accepted Answers:
   - to steer a car avoiding slip.

6) A wheeled mobile robot made with three omni-direction wheels
   - has two degrees of freedom.
   - has three degrees of freedom.
   - can be controlled by the rotation of the barrels.
   - can move without slip on a flat surface.

   No, the answer is incorrect.
   Score: 0
   Accepted Answers:
   - can move without slip on a flat surface.
No, the answer is incorrect.
Score: 0
Accepted Answers:
* has three degrees of freedom.

7) A practical wheeled mobile robot on a flat surface 2 points

- can move with zero slip.
- can move only with non-zero wheel slip.
- must generate tractive force by the deformation of the wheel or the ground.
- must generate tractive force by rotation of the wheel.

No, the answer is incorrect.
Score: 0
Accepted Answers:
* can move only with non-zero wheel slip.
* must generate tractive force by the deformation of the wheel or the ground.

8) can move with zero slip. 2 points

- is constant.
- is a function of only the normal ground reaction.
- depends only on the adhesion coefficient.
- lies between 0 and the product of adhesion co-efficient and normal reaction.

No, the answer is incorrect.
Score: 0
Accepted Answers:
* lies between 0 and the product of adhesion co-efficient and normal reaction.

9) The main kinematic difference between a wheeled mobile robot and a fixed base serial manipulator 2 points

- wheel-ground contact point give rise to non-holonomic constraints which reduces the degrees of freedom.
- wheel-ground contact point give rise to non-holonomic constraints which reduces the space of velocities.
- the moving base makes the wheeled mobile robot impossible to control accurately.
- the moving base leads to a smaller workspace of the robot which it is carrying.

No, the answer is incorrect.
Score: 0
Accepted Answers:
* wheel-ground contact point give rise to non-holonomic constraints which reduces the space of velocities.

10) A wheeled mobile on a generic uneven terrain 2 points

- can move without wheel slip.
- cannot move without wheel slip if the axle length is fixed.
- can move without wheel slip only if the axle length is variable.
- can move without wheel slip if the wheel can tilt and the distance between the point of contact with ground can change.

No, the answer is incorrect.
Score: 0
Accepted Answers:
* cannot move without wheel slip if the axle length is fixed.
2 points

11) The contact equations between two surfaces in single point contact (as shown in the lecture)

- are only for smooth and at least twice differentiable surfaces.
- model the five possible degrees of freedom between the two contacting surfaces.
- are in terms of the metric, curvature and torsion form of the two surfaces.
- are in terms of the derivatives of the variables describing the contact.

No, the answer is incorrect.
Score: 0

Accepted Answers:
are only for smooth and at least twice differentiable surfaces.
model the five possible degrees of freedom between the two contacting surfaces.
are in terms of the metric, curvature and torsion form of the two surfaces.
are in terms of the derivatives of the variables describing the contact.

2 points

12) As discussed in the Lecture, a planar 3R serial manipulator

- is redundant if only the \((x; y)\) position of the end-effector is considered.
- is redundant if the position and orientation of the end-effector is considered.
- is redundant since the Jacobian matrix is not square.
- is never redundant.

No, the answer is incorrect.
Score: 0

Accepted Answers:
is redundant if only the \((x; y)\) position of the end-effector is considered.

2 points

13) In the kinematic model of the human arm discussed in the Lecture

- only 4 joint rotations are considered as considering all the joints will make the model too complicated.
- only 4 joints are considered as the motion of the hand is constrained to be in a plane.
- only 4 joints are considered as the motion of the hand is in 3D space.
- only 4 joints are considered since 4 joints are enough to make the system redundant.

No, the answer is incorrect.
Score: 0

Accepted Answers:
only 4 joints are considered as the motion of the hand is constrained to be in a plane.

2 points

14) The contact equations (discussed in the lecture) for pure rolling

- are similar to the constraint equations for a rotary joint.
- are similar to the constraint equations for a spherical joint.
- are different from the constraint equations for a spherical joint since the equations are in terms of derivatives.
- are different from the constraint equations of a spherical joint since the degrees of freedom at the contact are different.

No, the answer is incorrect.
Score: 0

Accepted Answers:
are different from the constraint equations for a spherical joint since the equations are in terms of derivatives.

15) For the three wheeled mobile robot with torus shaped wheels and moving on uneven terrain (as discussed in the lecture)

- the trace of the wheel centre and the ground contact point is the same.
- the wheel tilts as it rolls.
- the wheel slip is negligible since the wheeled mobile robot is moving very slowly.
- the wheel slip is negligible since the distance between the point of contact with the ground is adjusting so as to have a instantaneous centre.

No, the answer is incorrect.
Score: 0
Accepted Answers:
the wheel tilts as it rolls.
the wheel slip is negligible since the distance between the point of contact with the ground is adjusting so as to have a instantaneous centre.

16) The kinematics of a three-wheeled mobile robot, discussed in the lecture

- has three independent actuations { two in the rear wheel and one in the front wheel.
- has passive tilting at the two rear wheels
- has passive rotation of the front steering wheel.
- has non-holonomic pure rolling constraints at the three wheels.

No, the answer is incorrect.
Score: 0
Accepted Answers:
has three independent actuations { two in the rear wheel and one in the front wheel.
has passive tilting at the two rear wheels
has passive rotation of the front steering wheel.
has non-holonomic pure rolling constraints at the three wheels.

17) The dynamics of a three wheeled mobile robot, discussed in the lecture, is

- similar to a 3 degree off freedom parallel manipulator.
- similar to a 3 degree of freedom parallel manipulator with wheel-ground contact modeled as a spherical joint.
- similar to a 3 degree of freedom parallel manipulator with wheel-ground contact modeled with non-holonomic constraints.
- similar to the three-fingered hand discussed earlier in the course.

No, the answer is incorrect.
Score: 0
Accepted Answers:
similar to a 3 degree of freedom parallel manipulator with wheel-ground contact modeled with non-holonomic constraints.

18) The solution of the direct kinematics problem for the three wheeled mobile robot on uneven terrain, discussed in the class, involve

- the solution of 15 ordinary differential equations in 21 variables.
- the solution of 15 ordinary differential equations and three algebraic equations in 21 variables.
- the solution of 21 ordinary differential equations and three algebraic equations in 24 variables.
19) The dynamic model of the three wheeled mobile robot on uneven terrain discussed in the lecture

- consists of 27 generalised coordinates and a similar number of differential equations.
- consists of 27 generalised coordinates and 24 constraint equations from the direct kinematics problem.
- consists of 27 generalised coordinates and 24 constraint equations from the inverse kinematics problem.
- consists of three actuating torques.

No, the answer is incorrect.
Score: 0
Accepted Answers:
* consists of 27 generalised coordinates and 24 constraint equations from the inverse kinematics problem.
* consists of three actuating torques.

20) The stability of a wheeled mobile robot moving on uneven terrain depends on...

- depends only on the speed of the robot.
- depends only on the unevenness of the terrain.
- depends only on the height of the centre of mass from the surface at that instant.
- depends on the net resultant force acting at the centre of mass.

No, the answer is incorrect.
Score: 0
Accepted Answers:
* depends on the net resultant force acting at the centre of mass.