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**NPTEL (https://swayam.gov.in/explorer?ncCode=NPTEL) » Robotics and Control: Theory and Practice (course)**

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# Unit 4 - Week 3



# Assignment 3

**The due date for submitting this assignment has passed.** **Due on 2020-02-19, 23:59 IST.**

## Assignment submitted on 2020-02-08, 15:22 IST

1) If K denotes the kinetic energy, P denotes the potential energy, L denotes the Lagrangian and $\theta_i : i = 1, 2, \ldots n$ denotes the joint variables of manipulator, then dynamic equation is given by: ***1 point***

- $d/dt(\partial L/\partial \dot{\theta}_i) - \partial L/\partial \theta_i = \tau$ and L=K+P
- $d/dt(\partial L/\partial \dot{\theta}_i) - \partial L/\partial \theta_i = \tau$ and L=K-P
- $d/dt(\partial L/\partial \dot{\theta}_i) + \partial L/\partial \theta_i = \tau$ and L=K+P
- $d/dt(\partial L/\partial \dot{\theta}_i) + \partial L/\partial \theta_i = \tau$ and L=K-P

Yes, the answer is correct.
Score: 1

Accepted Answers:
$d/dt(\partial L/\partial \dot{\theta}_i) - \partial L/\partial \theta_i = \tau$ *and L=K-P*

2) If V(x) denotes the Lyapunov function for the system $\dot{x} = f(x) : f(0) = 0$ then: ***1 point***

- $x = 0$ is stable if $V$ is positive semi definite and $\dot{V}$ is negative definite.

(unit?unit=56&lesson=66)

- Stability of Dynamical System (unit?unit=56&lesson=67)
- **Quiz : Assignment 3 (assessment?name=82)**
- Solution For Assignment 3 (unit?unit=56&lesson=92)

**Week 4**

**Week 5**

**Week 6**

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$x = 0$ is asymptotically stable if $V$ positive definite and $\dot{V}$ is negative semi-definite.

$x = 0$ is unstable if $V$ is positive definite and $\dot{V}$ is negative definite.

$x = 0$ is stable if $V$ is negative definite and $\dot{V}$ is positive semi-definite.

No, the answer is incorrect.
Score: 0

Accepted Answers:
$x = 0$ *is stable if* $V$ *is negative definite and* $\dot{V}$ *is positive semi-definite.*

3) If $M(\ddot{q}) + V(q, \dot{q}) + G(q) = \tau$ is the dynamic equation of n arm manipulator, then: ***1 point***

- M denotes the centripetal and centrifugal terms.
- V denotes the centripetal and centrifugal terms.
- V denotes Inertia term.
- M denotes friction term.

Yes, the answer is correct.
Score: 1

Accepted Answers:
*V denotes the centripetal and centrifugal terms.*

4) The degree d of the unique polynomial trajectory obtained using n conditions is given by: ***1 point***

- d=n-1
- d>n-1
- d=n
- d=n+1

No, the answer is incorrect.
Score: 0

Accepted Answers:
*d=n-1*

5) A point $x_e \in R^n$ is said to be an equilibrium point of the system $\dot{x} = f(t, x)$ ***1 point***

$f(t, x_e) = 0$ for some t.

$f(t, x_e) = 1$ for some t.

$f(t, x_e) = 0$ for all t.

$f(t, x_e) = 1$ for all t.

Yes, the answer is correct.
Score: 1

Accepted Answers:
$f(t, x_e) = 0$ *for all t.*

6) Finding joint torques given joint angles, velocities and acceleration as input is known as: ***1 point***

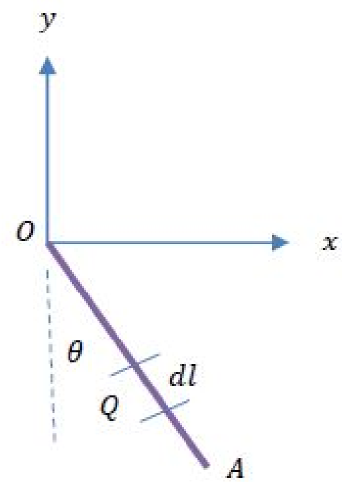
- Dynamics

- Kinematics
- Inverse Kinematics
- Inverse Dynamics

No, the answer is incorrect.
Score: 0

Accepted Answers:
*Inverse Dynamics*

7) Dynamic equation for single arm robot manipulator as shown in figure with length $l_1$ , torque $\tau$ and uniformly distributed mass M is given by: ***1 point***

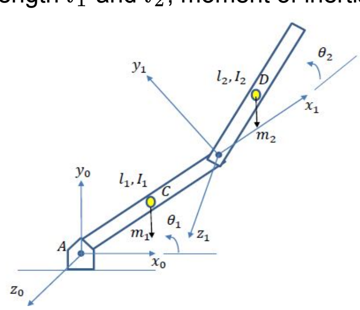



- $1/3ML_1^2\ddot{\theta} + 1/2MgL_1 sin\theta = \tau$
- $1/3ML_1^2\ddot{\theta} + 1/2MgL_1 cos\theta = \tau$
- $1/3ML_1^2\ddot{\theta} - 1/2MgL_1 sin\theta = \tau$
- $1/3ML_1^2\ddot{\theta} - 1/2MgL_1 cos\theta = \tau$

Yes, the answer is correct.
Score: 1

Accepted Answers:
$1/3ML_1^2\ddot{\theta} + 1/2MgL_1 sin\theta = \tau$

8) Consider following example of a two arm manipulator with uniformly distributed mass with length $l_1$ and $l_2$, moment of inertia $I_1$ and $I_2$ and mass $m_1$ and $m_2$ for respective links. ***1 point***



Then moment of Inertia of link 1 about A is :

- $1/3m_1l_1^2$
- $1/12m_1l_1^2$
- $m_1l_1^2$
- $1/2m_1l_1^2$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$1/3m_1l_1^2$

9) Consider same example as in (8), moment of inertia of link 2 about D is given by: ***1 point***

- $1/3m_2l_2^2$
- $1/12m_2l_2^2$
- $1/2m_2l_2^2$
- $m_2l_2^2$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$1/12m_2l_2^2$

10) Potential energy $P_2$ in (8) for link 2 is given by: ***1 point***

- $m_2g(l_1sin\theta_1 + l_2sin(\theta_1 + \theta_2))$
- $m_2g(l_1sin\theta_1 + l_2sin\theta_2)$
- $m_2g(l_1sin\theta_1 + l_2cos(\theta_1 + \theta_2))$
- $m_2g(l_1sin\theta_1 + 1/2l_2sin(\theta_1 + \theta_2))$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$m_2g(l_1sin\theta_1 + 1/2l_2sin(\theta_1 + \theta_2))$