Quizzes of TTK4225 - Systems Theory, Autumn 2020

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Question 23

the second order Taylor expansion of e^x centered around 0 is equal to ...

1. $1 + x + \frac{x^2}{2}$
2. $x + \frac{x^2}{2}$
3. $\frac{1}{2} + \frac{x}{4} + \frac{x^2}{8}$
4. $1 + \frac{x}{3} + \frac{x^2}{9}$
5. I do not know

Question 24

what is the frequency of the periodic signal $y(t) = \cos\left(20\pi t + \frac{\pi}{4}\right)$?

1. $f = 20$ Hz
2. $f = \pi/4$ rad
3. $\omega = 20$ rad/s
4. $\omega = 20\pi$ rad/s
5. I do not know

Question 25

the impulse response of the system $\dot{y} = -0.5y + u$ is equal to ...

1. $e^{0.5t}$
2. $e^{-0.5t}$
3. e^{2t}
4. e^{-2t}
5. I do not know

Question 26

the impulse response of a LTI system contains all the information that is needed to compute the trajectories of that system for every input u and initial condition y_0

1. true
2. false
3. it depends
4. I do not know

Question 27

the magnitude of e^{ja^2}, with j the imaginary unit, is ...

1. 0
2. 1
3. a
4. a^2
5. I do not know

Question 28

a phase portrait is . . .

1. a plot of how the variables of a system evolve in time for a fixed initial condition, plotted against time
2. a plot of how the variables of a system evolve in time for a fixed initial condition, plotted against each other
3. a plot of how the variables of a system evolve in time for every initial condition, plotted against time
4. a plot of how the variables of a system evolve in time for every initial condition, plotted against each other
5. I do not know

Question 29

that a system is globally asypmtotically stable means that ...

1. some of its trajectories converge in free evolution towards an equilibrium as time passes
2. all its trajectories converge in free evolution towards an equilibrium as time passes
3. some of its trajectories do not diverge in free evolution as time passes
4. all of its trajectories do not diverge in free evolution as time passes
5. I do not know

Question 30

the system

$$\begin{aligned}\dot{x}_c &= \left(-k_e - k_{c\to p}\right) x_c + k_{p\to c} x_p + u \\ \dot{x}_p &= k_{c\to p} x_c - k_{p\to c} x_p\end{aligned}$$

where x_c is the concentration of the drug in the central compartment, x_p the concentration of the drug in the peripheral compartment, u the drug injection profile, and $y(k) = x_c(k) + \varepsilon(k)$ a generic noisy measurement at time instant k, with ε normal, unbiased, i.i.d., and standard deviation σ, is ...

1. linear
2. nonlinear
3. piecewise linear
4. bilinear
5. I do not know

Question 31

$\left(x^3\right)^2 = \ldots$

1. x^1
2. x^5
3. x^6
4. x^9
5. I do not know

Question 32

consider a system having the following impulse response:

$$h(t) = \begin{cases} 2 & \text{for } t \in [0, 2) \\ 0 & \text{otherwise} \end{cases}$$

Then $y(3)$ is independent of ...

1. nothing, i.e., all the past inputs contribute to $y(3)$
2. $u(0)$, but not $u(1)$
3. $u(0)$ and $u(1)$
4. $u(0)$ and $u(1)$ and $u(2)$
5. I do not know

Question 33

consider a system having the following impulse response:

$$h(t) = \begin{cases} 2 & \text{for } t \in [0, 2) \\ 0 & \text{otherwise} \end{cases}$$

Then $y(3)$ is independent of ...

1. nothing, i.e., all the past y's contribute to $y(3)$
2. $y(0)$, but not $y(1)$
3. $y(0)$ and $y(1)$
4. $y(0)$ and $y(1)$ and $y(2)$
5. I do not know

Question 34

the system $\dot{y} = -0.5y + u$ forgets the past inputs faster than the system $\dot{y} = -1.5y + u$

1. true
2. false
3. it depends
4. I do not know

Question 35

$\log(xy) = \ldots$

1. $\log x + \log y$
2. $\log x \cdot \log y$
3. $(\log x)^{\log y}$
4. none of the above
5. I do not know

Question 36

A continuous-time LTI system whose poles are all in the right half-plane is just marginally stable

1. true
2. false
3. I do not know

Question 37

Which type of LTI systems may produce the following impulse response?

1. first order
2. second order
3. third order
4. I do not know

Open exercise

What is $y(t) = h * u(t)$ for the case

$$u(t) = \begin{cases} 1 & \text{for } t \in [1,2] \text{ and } t \in [2,3] \\ 0 & \text{otherwise} \end{cases} \qquad h(t) = \begin{cases} 2 & \text{for } t \in [0,2) \\ 0 & \text{otherwise} \end{cases} \qquad ?$$

Open exercise

Compute the general output $y(t)$ corresponding to the system $\dot{y} = bu$, $y(0) = y_0$

Open exercise

Compute the forced response of the system $\dot{y} = -0.5y + u$ to the input $u = e^{\beta t}$