ELIZADE UNIVERSITY, ILARA-MOKIN, ONDO STATE

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

SEMESTER II EXAMINATION, 2015/2016 ACADEMIC SESSION

COURSE TITLE: CONTROL THEORY

COURSE CODE: EEE 318

EXAMINATION DATE: 20TH JULY, 2016

COURSE LECTURER: DR, OGIDAN O.K.

HOD's SIGNATURE

TIME ALLOWED: 2HRS, 30MINS.

INSTRUCTIONS:

1. ANSWER QUESTION 1, AND ANY OTHER 3 QUESTIONS **(TOTAL OF 4 QUESTIONS)**
2. SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAM.
3. YOU WILL BE PROVIDED WITH A TIME/LAPLACE TRANSFORM SHEET FOR THIS EXAM.
4. YOU ARE NOT ALLOWED TO BORROW CALCULATORS AND ANY OTHER WRITING MATERIALS DURING THE EXAMINATION.

Note: Question 1 is compulsory

**Question 1**

a.) Define briefly the following

I. Transfer function

II. Modeling

III. System identification

IV. Bode plot

V. Nyquist stability criterion

b.) With the

A system has a transfer function: $G(s) = \frac{2}{(s+5)}$. Determine the magnitude and phase of the output from the system when it of subjected to a sinusoidal input of $2\sin 3t$.

**Question 2**

a.) What are the differences between open loop and closed loop system?

b.) Outline the differences between on-off control and the Proportional Integral Derivative (PID) control

c.) Write the following differential equations in the Laplace (s) domain

i. $F = m\frac{d^2y}{dt^2} + c\frac{dy}{dt} + ky$, initial value of variable $y = 0$ at $t = 0$

ii. $v = RC\frac{dvc}{dt} + vc$, initial value of variable $v = 0$ at $t = 0$

iii. $4\frac{d^2v}{dt^2} + 2\frac{dv}{dt} - y$, initial value of variable $v = 3$ at $t = 0$

iv. $\frac{d^2y}{dt^2} + 2\zeta w_n\frac{dy}{dt} + w_n^2 y = kw_n^2 x$, initial value of variable $y = 0$ at $t = 0$

**Question 3**

a.) A control system has two elements in series with transfer functions of $\frac{1}{(S+2)}$ and $\frac{1}{(S+4)}$

i.) Determine the overall transfer function

ii.) Write a programme (to be run in the MATLAB workspace) that inputs a unit step function into the system and to output a steady state response

b.) A system has an output $y$ related to the input $x$ by the differential equation:

$$\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + 6y = x$$

What will be the output from the system when it is subjected to a unit step input? Initially both the input and output are zero.

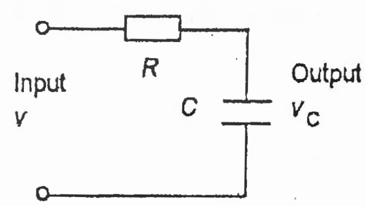
Hint: Use the Time/Laplace domain transformation table

**Question 4:**

a.) What are the differences between differential equation and transfer function?
b.) Outline the differences between first order and second order systems
c.) Give two examples of a second order system
d.) Give two examples of a first order system
e.) A system has a transfer function $\frac{1}{(s+5)}$. What will be its output as a function of time when it is subjected to a unit step input of 1V?

Question 5

a.) Describe the concept of stability and its importance in control systems
b.) Compare and contrast between classical and modern control systems
c.) Consider a circuit with a resistor R and capacitor C in series:




i.) Determine the transfer function for the circuit in c.
ii.) What will be its output as a function of time if it is subjected to a 5V ramp input?

| | Time function $f(t)$ | Laplace transform $F(s)$ |
|---|---|---|
| 1 | A unit impulse | $1$ |
| 2 | A unit step | $\frac{1}{s}$ |
| 3 | $t$, a unit ramp | $\frac{1}{s^2}$ |
| 4 | $e^{-at}$, exponential decay | $\frac{1}{s+a}$ |
| 5 | $1-e^{-at}$, exponential growth | $\frac{a}{s(s+a)}$ |
| 6 | $te^{-at}$ | $\frac{1}{(s+a)^2}$ |
| 7 | $t-\frac{1-e^{-at}}{a}$ | $\frac{a}{s^2(s+a)}$ |
| 8 | $e^{-at}-e^{-bt}$ | $\frac{b-a}{(s+a)(s+b)}$ |
| 9 | $(1-at)e^{-at}$ | $\frac{s}{(s+a)^2}$ |
| 10 | $1-\frac{b}{b-a}e^{-at}+\frac{a}{b-a}e^{-bt}$ | $\frac{ab}{s(s+a)(s+b)}$ |
| 11 | $\frac{e^{-at}}{(b-a)(c-a)}+\frac{e^{-bt}}{(c-a)(a-b)}+\frac{e^{-ct}}{(a-c)(b-c)}$ | $\frac{1}{(s+a)(s+b)(s+c)}$ |
| 12 | $\sin\omega t$, a sine wave | $\frac{\omega}{s^2+\omega^2}$ |
| 13 | $\cos\omega t$, a cosine wave | $\frac{s}{s^2+\omega^2}$ |
| 14 | $e^{-at}\sin\omega t$, a damped sine wave | $\frac{\omega}{(s-a)^2+\omega^2}$ |
| 15 | $e^{-at}\cos\omega t$, a damped cosine wave | $\frac{s+a}{(s-a)^2+\omega^2}$ |
| 16 | $\frac{\omega}{\sqrt{1-\zeta^2}}e^{-\zeta\omega t}\sin\omega\sqrt{1-\zeta^2}\,t$ | $\frac{\omega^2}{s^2+2\zeta\omega s+\omega^2}$ |
| 17 | $1-\frac{1}{\sqrt{1-\zeta^2}}e^{-\zeta\omega t}\sin\left(\omega\sqrt{1-\zeta^2}\,t+\phi\right)$, $\cos\phi=\zeta$ | $\frac{\omega^2}{s(s^2+2\zeta\omega s+\omega^2)}$ |