



PROGRAM : BACCALAUREUS TECHNOLOGIAE
EXTARCTION METALLURGY

SUBJECT : **PROCESS CONTROL IV**

CODE : **MPE 32-1**

DATE : EXAMINATION SSA 2019
DECEMBER 2019

DURATION : (Y-PAPER) 08:00 - 11:00

WEIGHT : 40 : 60

TOTAL MARKS : 100

EXAMINER : MR MK KALENGA 5142

MODERATOR : LM OMARI

NUMBER OF PAGES : 3 PAGES AND 3 ANNEXURES

INSTRUCTIONS : **QUESTION PAPERS MUST BE HANDED IN.**

REQUIREMENTS : CALCULATORS ARE NOT REQUIRED

INSTRUCTIONS TO CANDIDATES: *Question paper to be handed in*

PLEASE ANSWER ALL THE QUESTIONS.

QUESTION 1

Does the location of the zeros of a system affect its response to external inputs? Elaborate your answer.

[15]

QUESTION 2

A multiple pole p_3 which is repeated m times gives rise to terms such as those given below. The terms within the brackets grow toward infinity with time, independently of where pole p_3 is located. Explain then, why the overall term of the equation below decays to zero when p_3 is located on the negative real axis?

[15]

QUESTION 3

Find the solution of the following set of equations:

$$dx_1/dt = 2x_1 + 3x_2 + 2 \quad \text{with } x_1(0) = 0$$

$$dx_2/dt = 2x_1 + 3x_2 + e^t \quad \text{with } x_2(0) = 0$$

[20]

QUESTION 4

Consider the following second-order differential equation:

$$a_2 \frac{d^2 x}{dt^2} + a_1 \frac{dx}{dt} + a_0 x = f(t)$$

where $X(t)$ is considered to be in the form of a deviation variable with initial conditions

$$x(0) = \left(\frac{dx}{dt} \right)_{t=0} = 0$$

What would be the time function if:

1. $a_1^2 - 4a_2a_0 = 0$ and $a_1=2$, $a_2=1$ and $a_0=1$
2. $a_1^2 - 4a_2a_0 < 0$ and $a_1=2$, $a_2=2$ and $a_0=2$

[20]

QUESTION 5

Discuss the principal considerations that affect the scope of mathematical modeling of a metallurgical process.

[15]

QUESTION 6

Calculate the time function of the following Laplace transform:

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$$X(s) = 1/(s-1)^3(s+2)$$

[15]

TOTAL : 100
