PROGRAM: NATIONAL DIPLOMA
ENGINEERING: COMPUTER SYSTEMS
ENGINEERING: ELECTRICAL

SUBJECT: CONTROL SYSTEMS 2

CODE: ASY211

DATE: SUPPLEMENTARY EXAMINATION
27 JULY 2016

DURATION: (SESSION 1) 08:00 - 11:00

WEIGHT: 40 : 60

FULL MARKS: 100

TOTAL MARKS: 100

EXAMINER: DR THOKOZANI C SHONGWE

MODERATOR: MR DR VAN NIEKERK 2330

NUMBER OF PAGES: 7 PAGES, INCLUDING 2 SEMILOG GRAPH PAPERS AND 1 FORMULAE SHEET

INSTRUCTIONS: CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT)
USE ONLY THE ANSWER SHEET PROVIDED WITH THIS PAPER
INSTRUCTIONS TO CANDIDATES:

1. 100 MARKS = 100%
2. ATTEMPT ALL QUESTIONS.
3. THEORY TYPE QUESTIONS MUST BE ANSWERED IN POINT FORM BY CAREFULLY CONSIDERING THE MARK ALLOCATION.
4. QUESTIONS MAY BE ANSWERED IN ANY ORDER, BUT ALL PARTS OF QUESTION MUST BE KEPT TOGETHER.
5. ALL DIAGRAMS AND SKETCHES MUST BE DRAWN NEATLY AND IN PROPORTION.
6. ALL DIAGRAMS AND SKETCHES MUST BE LABELLED CLEARLY.
7. ALL WORK DONE IN PENCIL EXCEPT DIAGRAMS AND SKETCHES WILL BE CONSIDERED AS ROUGH WORK.
8. NOTE: MARKS WILL BE DEDUCTED FOR WORK WHICH IS POORLY PRESENTED.
9. NEGATIVE MARKING APPLIES IF YOUR ANSWER DOES NOT COMPLY WITH THE DETAIL REQUIRED AS REQUESTED IN CERTAIN QUESTIONS.

QUESTION 1

There are three different types of feedback controllers namely, Proportional, Integral and Derivative. When do you use these controllers, or what type of situation requires these controllers? Explain, giving the problems each type (or a combination) of controller creates and/or solves.

QUESTION 2

Consider the figure below and determine the transfer function using:

![Diagram](attachment:image.png)
a) **Block Diagram Reduction Method.**

b) **Mason’s Rule.**

c) **Kirchoff’s Method** (the algebraic method).

### QUESTION 3

Determine the transfer function of the passive network below

![Network Diagram]

### QUESTION 4

a) A network has a transfer function of \( G(p) = \frac{1}{p^2 + 6p + 62} \). Determine the transient response of the network to a step input of 10 Volts and express the output as a function of time.

b) Describe the concept of the decibel

c) The transfer function of the forward path of a closed-loop system is given by

\[
G(p) = \frac{300p(p^2 + 5p + 4)}{(p + 20)^2(p + 70)}
\]

and the transfer function of the feedback path is

\[
H(p) = \frac{1}{(p+1)}
\]

Use the straight line approximation method to draw a Bode plot (phase Vs frequency and magnitude Vs frequency) of the system consisting of \( G(p) \) and \( H(p) \) described above.
**QUESTION 5**

The table below shows the effects of increasing the PID parameters of feedback controllers. The table is partially filled. Completely fill in the table with the appropriate word or phrase (*Decrease* or *Increase* or *Small Change*).

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>RISE TIME</th>
<th>OVERSHOOT</th>
<th>SETTLING TIME</th>
<th>S-S ERROR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kp</td>
<td></td>
<td></td>
<td></td>
<td>Small Change</td>
</tr>
<tr>
<td>Ki</td>
<td></td>
<td></td>
<td></td>
<td>Eliminate</td>
</tr>
<tr>
<td>Kd</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[10]

**TOTAL MARKS : 100**
Annexure A

Laplace Transforms

<table>
<thead>
<tr>
<th>TIME FUNCTION f(t)</th>
<th>LAPLACE FUNCTION F(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit impulse</td>
<td>1</td>
</tr>
<tr>
<td>Unit step</td>
<td>( \frac{1}{p} )</td>
</tr>
<tr>
<td>Unit ramp</td>
<td>( \frac{1}{p^2} )</td>
</tr>
<tr>
<td>Unit parabolic</td>
<td>( \frac{1}{p^3} )</td>
</tr>
<tr>
<td>Exponential (e^{at})</td>
<td>( \frac{1}{p + a} )</td>
</tr>
<tr>
<td>Sinusoidal (sin(\omega t))</td>
<td>( \frac{\omega}{p^2 + \omega^2} )</td>
</tr>
<tr>
<td>Co-sinusoidal (cos(\omega t))</td>
<td>( \frac{p}{p^2 + \omega^2} )</td>
</tr>
<tr>
<td>( \frac{1}{(n-1)!} t^{n-1} e^{-\alpha t} )</td>
<td>( \frac{1}{(p + a)^n} )</td>
</tr>
<tr>
<td>( e^{\alpha t} \sin(\omega t) )</td>
<td>( \frac{\omega}{(p + a)^2 + \omega^2} )</td>
</tr>
<tr>
<td>( e^{\alpha t} \cos(\omega t) )</td>
<td>( \frac{p + a}{(p + a)^2 + \omega^2} )</td>
</tr>
</tbody>
</table>