

*School of Technology*

Electronics and Sound

ASSESSED WORK

|  |  |
| --- | --- |
| Module: | Control and PLC (5EJ057) |
| Assessment Number | 1 |
| Module Leader: |  |
| Marking Tutor: |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
| Submission Date | Week 40 |

For this assignment you will derive transfer function for simple permanent magnet DC motor, examine the system behaviour and the effects of some modelling assumptions. You will than undertake the laboratory experiments, in workbook control I, using the similar DC motor to confirm some of your findings.

The DC motor is a common actuator system that converts electrical energy into rotational mechanical energy. In the case of permanent magnet DC motor whose stator consists of a permanent magnet we can take the field current to be constant (i.e. a constant magnetic field) and it can be shown that the torque is proportional to the armature current:



The back-emf voltage is proportional to the shaft speed:



Summing the loop voltages gives:



Summing the angular forces present at the motor’s output shaft yields:



Above equations can be used to create the block diagram representation of the motor. ‘Blind’ version of this diagram is shown below.

Ea(s) +

Ia(s)

(s)

s(s)

T(s)

Eb(s)

Blind Block Diagram of the DC motor described in question

**TASKS:**

1. By taking the Laplace transform of the above equations fill in the empty blocks of diagram.

b) State the units for all constants used in the above equations.

c) What is the forward path transfer function of DC block diagram?

d) What is the feedback path transfer function of DC motor block diagram?

e) Determine the closed loop velocity transfer function and state the order of the system.

f) Use Matlab/Simulink to develop a computer simulation of derived block diagram using the following data:

Ra = 0.6 ; La = 0.012 H; I = 1.8kgm2;

 = 0.6 …………….; km = 0.12 …………….; kb = 0.12 …………….

i.e. determine the motor velocity step response to a step change in applied voltage from 0V to 240 V.

*(Note: units for constants , km and kb are determined in part b)*

j) Carry out the experiment in workbook control I. Answer all the questions and plot diagrams where appropriate. Comment on your results and compare to the results obtained by simulation. Write a conclusion to each experiment to reflect your involvement and understanding of the experiment.

**Assessment**

In order to pass the module THIS ASSESSED WORK MUST BE ATTEMPTED AND THE WORK SUBMITTED VIA THE STUDENT OFFICE. Assessment is based upon the achievement or non-achievement of learning outcomes and the grade achieved. In evaluating the student’s performance the assessor compares the product with the set of grade descriptors shown in the Assessment Grade table in the Assessment Regulations handbook or Rights, Responsibilities and Regulations handbook. The alpha grade, achievement or non-achievement of learning outcome(s) are reported on the Student Assessment Record and Receipt Form. In BTEC programmes this form also indicates grades P (Pass), M (Merit), or D (Distinction) where a student is successful in achieving a common skills outcome(s).

Learning outcomes for the assessed work are specified within the module in the Programme Learning Outcomes, Module Learning Outcomes, Indicative Content, Teaching and Learning Strategies, Resource and Assessment Methods handbook. Common skills outcomes in BTEC programmes are detailed in the Programme and Study Guide.

NB A Pass grade (D- or better) is not necessarily an indicator that the learning outcome(s) have been achieved.

**Assessment Criteria**

**A+ to B+**

Outstanding, of exceptionally high standard to a very good standard. *Completion of all parts of the work with correctly calculated results and extensive analysis as required. Your conclusions must be comprehensive, correct and thoroughly justified. The work presented must be of the highest standard, with appropriate use of graphs and diagrams.*

**B to C-**

Generally very good to quite good. *Completion of all parts of the work with correctly calculated results and analysis as required. Your conclusions must be correct. The work should be presented in a tidy and clear format, with appropriate use of graphs and diagrams.*

**D+ to D-**

Fair standard to borderline between satisfactory and unsatisfactory standard. *Completion of most parts of the work with some defects in calculated results, analysis and conclusions. The work presented should be of a moderately presented standard.*

**Fm to Fm-**

Unsatisfactory standard with serious shortcomings. *Incomplete work or work with significant errors in calculated results, analysis and conclusions. The work presented may be of a poor standard.*

**F to NR**

Very poor standard to exceedingly poor or nothing of merit. *Failure to make a reasonable attempt at all parts of the assignment with little evidence of results, analysis and conclusions. The work presented may be of an unacceptable standard.*

**Assignment Presentation and Submission**

Assessed work should be presented for marking in a flat A4 file. The work must be submitted with an enclosed completed Student Assessment Record and Receipt Form to the Student Office BY THE SUBMISSION DATE.

NB Work handed in UP TO ONE WEEK LATE will receive the MAXIMUM GRADE OF D-. Work WILL NOT BE ACCEPTED after this additional period unless submitted with a signed form APPLICATION FOR CONSIDERATION OF EXTENUATING CIRCUMSTANCES (ACE1). SUBMISSION OF WORK IN PLASTIC OR OTHER TYPES OF WALLET IS NOT ACCEPTABLE.