

**Faculty of Engineering, Environment and Computing**

##### 102CDE Module Title Electrical Engineering 1

**Assignment Brief 2018/19**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Module Title Electrical Engineering 1 | Ind/Group | | Cohort (Sept | Module Code  102CDE |
| Coursework Title (  DC Motor: Voltage Control and H-Bridge | | | | Hand out date:  Week 10 |
| Lecturer  Dr Andrew Jason Tickle, Dr John Arvanitakis | | | | Due date:  January 7th, 2019 |
| Estimated Time (hrs.): 12 in Total (1 hour in lab to collect data) | | Coursework type: Computer Simulation, Experimental Report | | % of Module Mark  25 % |
| Submission arrangement online via CUMoodle:  File types and method of recording:  Mark and Feedback date: -  Mark and Feedback method: Comments via Grade Book | | | | |

|  |
| --- |
| Module Learning Outcomes Assessed:   1. Study of the DC Motor, a widely used motor in many applications. 2. Model and simulate the H-Bridge, a fundamental electronic circuit used for the control of DC Motors. 3. Actual implementation of the H-Bridge, and learn to operate a DC Motor. |
| **Module 102CDE Electrical Engineering 1**  **DC Motor: Voltage Control and H-Bridge**  Theory and further instructions for the completion of this assessment can be found in Moodle in the “DC Motor Additional Material” and “DC Motor Assessment Presentation” files.  Required Equipment:  For the completion of the experimental part of this assessment the following equipment will be provided:   * 1x DC-Motor, 5V maximum input voltage. * 1x Hall Effect Sensor * 1x Breadboard * 2x ZTX 751 PNP Transistor, 2A maximum current * 2x ZTX 651 NPN Transistor, 2A maximum current * 4x 1N4000 Diodes * 4x 1kΩ Resistances   **ATTENTION!**  All components work with a maximum voltage of 5V. Any voltage higher than that will lead to irreversible damage of the equipment. If you are unsure of the connections done in the experimental set-up, please advise with the supervisor of the Laboratory sessions.  **Tasks and Marks Distribution**  **Task 1: Simulation (*20 Marks*)**  Simulate in Multisim a H-bridge circuit, considering the components mentioned above. Use a DC-Motor to validate the correct simulation of the H-Bridge by measuring the voltage drop across the DC-Motor terminals for each case. Execute the following procedures and list your results.   1. In forward and reverse rotation, note the Base-Emitter (VBE) and Base-Collector (VBC) Voltages for each transistor used. 2. What is the operating current for the DC-Motor in each case? 3. For all possible combinations of the transistor acting as ‘switches’ (open – close), note what happens to the DC-Motor, in terms of voltage difference across motor’s terminals.   **Task 2: DC-Motor Voltage-Speed Characteristic (*30 Marks*)**   1. Connect the motor provided to a DC Voltage source. Connect the Hall effect sensor to the motor. Connect a 5V voltage source to the sensor terminals. 2. Power the DC Motor by slowly increasing the input voltage of the motor VM from 0V to 5V by increments of 0.5V. Using an oscilloscope, depict the Hall effect sensor output signal. Note in the table below the time needed, T10R for 10 full rotations for each case. Using the measured time, estimate the rotational speed of the DC Motor in RPM. Depict in a diagram the Voltage-Speed Characteristic of the Motor.  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | VM (V) | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 3.5 | 4 | 4.5 | 5 | | T10R (msec) |  |  |  |  |  |  |  |  |  |  | | ωr (RPM) |  |  |  |  |  |  |  |  |  |  |   **Task 3: H-Bridge Implementation (3*0 Marks*)**  With the components provided, construct the H-Bridge circuit. Provide evidence of the correct operation of the H-Bridge.  **Task 4: Literature review (2*0 Marks*)**  The H-Bridge circuit effectively allows the change in the current direction flowing through the DC-Motor. In most cases a Pulse Width Modulated (PWM) signal is used in conjunction with the H-bridge to alter the voltage across the motor terminals -and hence the speed of the motor. Based on a literature review, state the operating principle of the PWM signal, and how it is used with the H-Bridge to control the motor speed.  Please provide with a brief presentation of other forms of speed control available apart from the H-Bridge. |
| Notes:   1. You are expected to use the [CUHarvard](https://curve.coventry.ac.uk/open/file/bdfb947c-9d43-48d3-8ec8-f511682e1dd1/1/The%20CU%20Guide%20to%20Referencing%20in%20Harvard%20Style.pdf) referencing format. For support and advice on how this students can contact [Centre for Academic Writing (CAW)](http://www.coventry.ac.uk/study-at-coventry/student-support/academic-support/centre-for-academic-writing/?theme=main). 2. Please notify your registry course support team and module leader for disability support. 3. Any student requiring an extension or deferral should follow the university process as outlined [here](https://share.coventry.ac.uk/students/Registry/Pages/Deferrals-and-Extension.aspx). 4. The University cannot take responsibility for any coursework lost or corrupted on disks, laptops or personal computer. Students should therefore regularly back-up any work and are advised to save it on the University system. |