

Advanced Diploma Robotics and Mechatronics Engineering

(DMC - 52872WA)

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| **Student full name:** | |  | | |
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| Please place a tick (☑) in the box below to indicate that you have read, understood, and certify the above statement.  Please include this page in/with your submission.  Any electronic responses to this submission will be sent to your Moodle account.  **AGREEMENT**       **DATE:** | | | | |
|  | | | | |
| Achieved / To be Achieved: | | | | |
| Assessor: |  | | Date: |  |
| Overall feedback: |  | | | |

**Guidelines for Students**

**How is this unit assessed?**

After completion of this assessment, you will be given a result of ‘Achieved’ or ‘To be Achieved’. The assessor will give you feedback via Moodle and you will have an opportunity to submit additional evidence if you have received a ‘To be Achieved’ result.

You will be allowed one (1) opportunity to resubmit the same assessment task, if required.

Once all assessment tasks for this unit have been completed, you will be given a final unit result of ‘Competent’ or ‘Not Yet Competent’. If you are deemed ‘Not Yet Competent’ in a unit after all resubmission attempts, you will be required to re-sit the unit.

**How is this assessment task assessed?**

For a result of ‘Achieved’ in this assessment, all unit elements (as indicated on page 4) must be completed to a satisfactory standard.

At Advanced Diploma level a ‘satisfactory’ standard, as stipulated by the Australian Qualifications Framework, means that you will demonstrate the application of knowledge and skills:

* with depth in areas of specialisation, in contexts subject to change
* with initiative and judgment in planning, design, technical or management functions with some direction
* to adapt a range of fundamental principles and complex techniques to known and unknown situations
* across a broad range of technical or management functions with accountability for personal outputs
* personal and team outcomes within broad parameters

Assessors also make decisions based on the following considerations:

* all parts of this assessment have been completed to a standard that satisfactorily meets the requirements set out in the assessment criteria (as per the unit outline).
* the assessment evidence provided is the student’s own work, except as appropriately acknowledged by the use of referencing.
* the evidence is recent and the student’s knowledge is up-to-date.

**Assessment Instructions:**

1. You must answer ALL questions.
2. Please ensure you complete your answers in a blue font (not red or black).
3. The best marks can be earned by giving concise, brief answers that address the questions.
4. You must reference all content used from other sources including course materials, slides, diagrams, etc. Do not directly copy and paste from course materials or any other resources.   
   Refer to the referencing section of the EIT eLibrary on Moodle for referencing guides.
5. Use this document for completing your answers by typing the answers after each question without deleting the question. Make sure that you preserve the original question number format.
6. Do not add extra pictures, etc. as annexures; instead, paste them directly into this answer sheet. Hand-drawn sketches can be inserted after scanning but please ensure that the file size does not become big (more than 10 MB). You must refer to all diagrams and pictures, etc. that you have drawn or pasted in.
7. When saving your document (must be Word format), ensure you include your name in the title: COURSECODE\_MODULE#\_ASSESSMENTTYPE\_VERSION#\_YOURNAME

**E.g. DMC\_DMCPIC613\_WrittenAssessment\_v1\_JohnSmith**

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| --- | --- |
| **Unit no. and name:** | **DMCPIC613: Develop PIC programs** |
| **Assessment type:** | **Written** |

**Assessment Points:**

* Supply the required answers below in blue font (not red or black).
* You must submit this assessment along with the practical component.
* You must answer all questions.

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| **Q1** | We want to use a PIC16F84A microcontroller where 2 inputs (to the microcontroller) are to be connected to pins RA0 and RA1 (PORTA) and 3 outputs (from the microcontroller) are to be connected to RB1, RB2, RB3 (PORTB). Explain how configuring these individual pins into input or output can be done. | | |
| **A1** | **Student answer:**   * **Two inputs are connected to pins RA0 and RA1** * **Three outputs are connected to pins RB1, RB2, RB3**   **Code for the connections:**  **BCF STATUS, RPO; Bits clear in register**  **CLRF PORTA; Port A and port B are initialized**  **CLRF PORTB; by clearing the bits**  **BSF STATUS RPO; Port A and port B are located in bank 1**  **MOV LW OX03; To initialize data directions**  **MOV WF TR1SA; Set RA <1:0> as inputs**  **MOV LW 0X00; To initialize data directions**  **MOV WF; To initialize data directions**  **MOV WF TR1SB; RB <3:1> configured as output**  **To configure port pin as an input “logic 1” is written to the corresponding pin. To configure a port pin as an output “logic 0” is written to the corresponding pin. Reset pins are configured as an output** | | |
| **F1** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q2** | You are developing an application that uses 190 bytes of RAM. You have the choice between using PIC16F84A or PIC16F688. Which microcontroller you would select and why? | | |
| **A2** | **Student answer:**  **I would choose the second option PIC16F688 which has 256 bytes of data RAM. The first option PIC16F84A only has 68 bytes of data RAM and this is not enough for the required application which uses 190 bytes of RAM** | | |
| **F2** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q3** | What is the relation between a PIC16XX microcontroller’s clock speed and its power consumption? | | |
| **A3** | **Student answer:**  **The relationship between a PIC16XX Microcontroller’s clock speed and its power consumption is directly proportional to each other and linearly dependent on each other. The single largest factor in the PIC16XX microcontroller power consumption is the clock speed. The power consumed by a microprocessor is directly proportional to its operating clock speed. According to this, a device operating at the lowest clock speed will produce the maximum power savings. If you decrease the clock speed, usually you can decrease the supply voltage. The microcontroller performance is directly proportional to the clock speed. This means that the power consumption can be reduced but the performance is going to be affected. Higher clock speeds mean higher power consumption, but also more computational power. We can say that the choice of clock speed is a trade off between power consumption and the required computational power.** | | |
| **F3** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q4** | Draw a block diagram showing a microcontroller used to control a small robot. Include the inputs and outputs of the microcontroller. The microcontroller should receive sensor data and should produce outputs to control its motors. | | |
| **A4** | **Student answer:** | | |
| **F4** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q5** | You are asked to develop a program and test it on a microcontroller. What are the three main steps you would follow to do so (do not include simulation)? For each step name the software and/or hardware tools that are needed to execute it. | | |
| **A5** | **Student answer**  **The three main steps are**   1. **Write the program code in your computer** 2. **Compile the code with a compiler for the microcontroller you are using** 3. **Upload the compiled version of your program to your microcontroller**   **For the first step we need a higher-level language such as C, C++ or Java.**  **One of the essential tools needed to program a microcontroller is an integrated development environment (IDE). This software is usually developed by the creators of the microcontroller and contains useful tools to help you program your microcontroller. Common tools found in IDE’s include code editors, compilers, and debuggers. Depending on the application of the microcontrollers, additional features may be added as well. Once a suitable IDE is obtained, you can begin writing code.**  **The second step is almost always handled by the IDE. While we typically program microcontrollers in higher level languages, the microcontroller itself runs on assembly. To translate code to a format usable by a microcontroller, a compiler must be used. A compiler is a software tool that takes higher level code and optimizes it for assembly. Assembly provides specific instructions to the microcontroller on what register operations to perform to match the operation of the original code.**  **For the third step, once your code is written, it must be uploaded to the microcontrollers. Most have USB interfaces, but some smaller microcontrollers require a special hardware to be programmed** | | |
| **F5** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q6** | What is an interrupt? | | |
| **A6** | **Student answer:**  **An interrupt is a signal to the processor emitted by hardware or software indicating an event that needs immediate attention. Whenever an interrupt occurs, the controller completes the execution of the current instruction and starts the execution of an Interrupt Service Routine (ISR) or Interrupt Handler. ISR tells the processor or controller what to do when the interrupt occurs. The interrupts can be either hardware interrupts or software interrupts.** | | |
| **F6** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q7** | Name the sources of interrupts on a PIC16F84A? | | |
| **A7** | **Student answer:**  **The PIC16F84A has 4 sources of interrupt:**  **• External interrupt RBO/INT pin**  **• TMRO overflow interrupt**  **• PORTB change interrupts (pins RB7:RB4)**  **• Data EEPROM write complete interrupt** | | |
| **F7** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q8** | Explain how a program is transferred to a PIC microcontroller. Clarify whether the code is transferred as a text or a hexadecimal file. | | |
| **A8** | **Student answer:**  **To program a microcontroller, you need a device called a Burner/Programmer and software (Boot loader). The burner and the dedicated software perform the function of transferring a .Hex file into the PIC. The burner is connected to the PC via a serial cable.**  **As expressed above the file transferred to the PIC is a Hex file.** | | |
| **F8** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q9** | Why is it important to clear the INTF bit for PIC16F84A microcontroller? | | |
| **A9** | **Student answer:**  **It is important to clear the INTF bit because we don’t want an interrupt to occur again while going back to the main program** | | |
| **F9** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q10** | How are interrupts disabled on a PIC16F84A microcontroller? | | |
| **A10** | **Student answer:**  **The interrupts can be enabled or disabled by giving a value of 1 or Zero to the bits on the INTCON register or doing the same on the PIE registers.** | | |
| **F10** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q11** | Explain how to Read the EEPROM on a PIC16F84A? | | |
| **A11** | **Student answer:**   * **The required address is placed in EEADR** * **The RD bit is set in EECON1** * **The data in that memory location is then copied to the EEDATA register and can be read immediately** | | |
| **F11** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q12** | Explain how you would control steering in a two wheels robot. | | |
| **A12** | **Student answer:** | | |
| **F12** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q13** | Write the Assembly Code for PIC16F84A microcontroller to switch from Bank 0 to Bank 1. This is done by setting the STATUS register, which is at address 03h, bit 5 to 1: Add comments to each line to explain what the code does.  Do you have to follow the same steps if you are writing a program in PIC BASIC? | | |
| **A13** | **Student answer:**  **bsf 03h,5; Go to Bank 1**  **movlw 00h; Put 00000 into W**  **movwf 85h; Move 00000 onto TRISA – all pins set to output**  **bcf 03h,5; Come back to Bank 0** | | |
| **F13** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q14** | You are designing a program for a robot controlled by a PIC microcontroller. The robot has a bump detector switch wired to one pin of the microcontroller. The robot should go forward until it hits an obstacle. As soon as the robot hits an obstacle (the bump switch sends a ON signal), the robot should stop, turn right by 90 degrees and then continue its forward motion.  Your main program contains the forward motion. You have also available a list of instructions to turn right by 90 degrees.  Explain how you would manage the interruption of the main program (forward motion) when the bump detector switch detects an obstacle. Then how the program will continue the forward motion when the turn right is finished. | | |
| **A14** | **Student answer:** | | |
| **F14** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q15** | Write the Assembly Code for PIC16F84A microcontroller to read a switch connected to Bit 2 of PORTB. You will need to first set the pin to an input, then test whether the pin is 0 (switch closed), if so go to existing program at label SWITCH, If not the program is to continue: Add comments to each line to explain what the code does. | | |
| **A15** | **Student answer:** | | |
| **F15** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q16** | Write the same program of Question 15 in PIC BASIC. | | |
| **A16** | **Student answer:** | | |
| **F16** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q17** | Explain how you would generate a PWM output on a PIC microcontroller output.  a) Write the code in PIC BASIC to create such PWM output.  b) Compare the effort to write PIC BASIC code to the effort one has to make to write the same in Assembly. | | |
| **A17** | **Student answer:** | | |
| **F17** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q18** | Explain how PWM is used in servo control. | | |
| **A18** | **Student answer:** | | |
| **F18** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q19** | Explain how you would use a PIC microcontroller to control a stepper motor. Include in your explanation how pins would be wired to the stepper motor (bipolar or unipolar) and the output patterns to generate. | | |
| **A19** | **Student answer:** | | |
| **F19** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |
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| **Q20** | 1. Write a program in PIC BASIC that generates the necessary sequence for a unipolar stepper motor in half-step mode. 2. How you would control the speed of the stepper motor? | | |
| **A20** | **Student answer:** | | |
| **F20** | **Assessor feedback:** | Achieved |  |
| To be achieved |  |

**END OF ASSESSMENT**