Coursework cover sheet – be sure to keep a copy of all work submitted

Submit online via Moodle

Submit through Moodle as a pdf document naming the file name

with your student identification number (eg 1234567.pdf).

Section A - To be completed by the student – PLEASE PRINT CLEARLY

Family Name(s)			Module No. **201AEE**
Forename(s)			
ID Number(s) (from your student card)			
Time taken (hrs) (per student for group coursework)			
Lecturer: Dr. L. K. Verma		Submit individual elogbook & group report via the Moodle site by 23:55 on **10/Jan/2018**	
Module Code and Title: 201 AEE Embedded Microprocessors Group Project (EMGP)			
Assignment No. / Title: Assignment 1 – Design an intelligent Navigation Robotic vehicle (revised)			
Estimated Time (hrs): **25**	Assignment type: Individual	% of Module Mark: **50**	Hand out date: 21 Nov 2017

No late work accepted. Extensions allowed only in extenuating circumstances. It is important that the work submitted is an individual effort. The penalties for plagiarism are severe. Full details on Faculty coursework policy and procedures are available at https://students.coventry.ac.uk/EC/Pages/Procedures.aspx

Section B - To be completed by the assessor

Intended Learning Outcomes assessed by this work.

1. Identify, review and select techniques, procedures and methods to undertake engineering tasks associated with a microprocessor system using a development board, interfacing modules and software for an application, considering the constraints of cost, as well as environmental and safety factors.
2. Contribute to the design, development and implementation of microprocessor engineering solutions.
3. Manage the planning, budgeting and organisation of tasks, people and resources associated with project and product development.
4. Develop demonstrable interpersonal skills.

Marks breakdown	Max	Awarded

1. Individual Electronic Logbook (10 marks)

– submit online via moodle.

2. Group Report (total 80 marks, break down as below)

– submit online via moodle & hardcopy report

Project introduction (3 marks)

Main Body

(a) Design & Implementation:

i. Schematic capture, PCB layout/gerber, 3D layout (7.5 marks x2) - Hardware

ii. Code development (15 marks) – Firmware

(b) Component selection / Cost analysis (5 marks) - Hardware

(c) Software flowchart (5 marks) - Firmware

(d) Working Prototype build (15 marks) – Hardware / Firmware

(e) Hardware Modular Testing & Firmware Modular Testing/Simulation (10 marks) – Hardware / Firmware

(f) Integrated Testing / Validation (15 marks) – Hardware / Firmware

(g) Team work (10 marks) – Hardware / Firmware

Conclusion (7 marks)

3. Individual group member Poster Presentation & Q&A (10 marks)

Total: 100 marks @ 50% weight-age to final marks

No copying is allowed. Student found to plagiarize may be referred to the school for action and zero marks will be awarded for both students.

Assessor's signature / initials:	Date:	Total	Total
Dr. L. K. Verma	31 Jan 2018	100 marks	
Signed internal moderator:	This work may have been moderated. You may find additional comments in the work.		
This section may be used for feedback or other information			

Coursework Task Sheet

Assessment Criteria

The assessment consists of a group report, your individual Electronic Logbook and individual contribution to a group Poster Presentation. The report must consist of an introduction, sections that describe the design, implementation and testing processes, and a conclusion. A demonstration of the project at the end of the module is required and marks will be awarded for according to the above marking criteria.

The work will be assessed by comparison with an approved marking scheme. Fully correct solutions will receive the number of marks indicated. Marks will be reduced for errors in proportion to their severity. You should indicate the units for all your results.

Please present your work clearly showing all appropriate equations used for calculations and indicating all the steps needed to get the final answers.

Retain at least 2 digits after decimal point.

TASK

The tasks are chosen to enable you to get experience in the design, implementation and testing of real-time systems.

Task description

You will need to reference the task sheets you have been given in your lab/lecture classes and which are available on the module area in Moodle.

Design, implement and test a solution to the following problem:

You will be using a PIC18F4520 microcontroller board or any assigned MCU development kit from the lab to control a Robotic vehicle consisting of two stepper motors that control the locomotion aspect of the vehicle via a Darlington driver. A Sharp Proximity Sensor will be used to scan for the presence of an obstacle within a specified area of vision. A Photo-Reflective Optical sensor will be used for sensing marked points along the vehicle's path. A single 7-segment LED and a buzzer will also be used that will provide visual and audible feedback of system progress.

The laboratory aspect of the assignment is of a four, 3-hour session duration.

The following tasks must be completed by the group:

1. Design an intelligent **Navigation** Robotic vehicle that performs the following tasks:
   - **a.** On system initialization the vehicle should move in a forward direction in a straight path. The locomotion for the vehicle should be implemented by using two stepper motors driven in a full step mode by using Port of the micro interfaced with a stepper motor driver.
   - **b.** The path that the vehicle would follow is marked by a number of markers implemented by using strips of black tape. These markers are placed at random intervals along the path.
   - **c.** The vehicle should be able to detect and count these markers. The sensing of these markers should be implemented by using a Photo-Reflective Optical sensor mounted at an appropriate position underneath the vehicle.
   - **d.** Every time one of these markers is encountered the system should respond by giving an audio signal through a Piezo Buzzer. A visual response should also be given by a single 7-segment LED.

e. Every marker encountered by the vehicle in its path should be counted and the appropriate accumulated value of these should be given as an audio and visual feedback.

f. An obstacle is placed at a random point along the vehicle's path. If the vehicle senses this object by a front mounted Sharp Proximity sensor at a distance of 25 cm or less the vehicle should initially pause for a short duration and then continue by reversing along the path while counting down every marker encountered from the previously counted value and should also provide the appropriate audio and visual feedback by sounding/flashing the counted down value of markers. When the vehicle arrives at the last marker, (i.e. the initial starting position) the vehicle should stop. At this point you have your individual option of demonstrating the task completion by using an audio – visual feedback.

There are five scenarios that the prototype will be tested **(with regards to the obstacle navigation)**:

i. Forward direction with no obstacle.
ii. Forward direction with obstacle. Vehicle to move back and turn either left or right.
iii. Forward direction with obstacle in front and on the left. Vehicle to move back slightly (**optional**) and turn right and proceed to move forward thereafter.
iv. Forward direction with obstacle in front and on the right. Vehicle to move back slightly (**optional**) and turn left and proceed to move forward thereafter.
v. Forward direction with obstacle in front, on the left and on the right. Vehicle to move back slightly and clear from all obstacles and rotate 180 degree and continue to move forward thereafter. **The counter of the 7-segment during the forward path (up count) and reverse path (down count) will be counted. Upon reaching zero it will stop the vehicle. (bonus feature).**

2. The student is to design a complete hardware circuit and should take into account the various blocks:

a. The stepper motors and its driver circuit
b. 3 proximity sensors – for front, left and right
c. 1 optical sensor (to count the back/white strip on the ground)
d. 1 7-segment LED
e. 1 buzzer with driving transistor.

The development kit will be represented as a module in the completed hardware design and do not need to design the detailed PIC18F4520 MCU circuit. Connector provisions should be made for connecting your circuit to the development kit module.

A schematic must be captured, showing clear details of all parts of the schematic and to be included in your report.

3. A PCB of your design should be included in your report showing the PCB layer(s) and the 3D view. The size of your PCB design should not exceed 5cm x 5cm (or 2" x 2"). You have a choice of a single or double layer board design. All selected PCB component can be either Through Hole or

Surface Mount Technology type. Your PCB should be a 0.8 mm FR4 laminate, 1 ounce copper. The pcb (including the 3D view) and gerber file must be captured in your report.

4. A full listing of the Bill Of Materials (BOM) should be included in your report with full references of component supplier's order codes and prices. All components chosen should be ROHS approved. An overall cost of your design should be given including your PCB manufacturing quote. Your BOM should NOT include System tools, Development tools or Mechanical components in your overall project cost. Only provide the BOM for your PCB manufacture, ALL components mounted on your PCB, the external proximity sensor the external Photo Reflective sensor, the Piezo buzzer the Lithium Ion or Lithium Polymer battery and the 2 steppers.

5. Your functional demo of your design should be uploaded as a YouTube video clip and a link to this should be provided in your report. A staff signed note that shows the group name and group member names should be shown in your video clip.

6. Only one group report should be submitted by one team member. This could be a PDF together with a print copy of the report.

The assignment report file name should begin with the **group's name** and the **up-loader's surname**. The other group members should upload a cover sheet with the filename: **coversheet** followed by the **group's name.** The cover sheet template is provided on Moodle.

GROUP MARK

1. **Introduction [3 marks]**. This will set the scene for the report, providing information on **how you planned** your work and what objectives you were attempting to meet. . A Gantt chart should be included in your report showing your planned activities against time. You should also include a Project Management and Risk Assessment discussion.

2. The **Main Body** of the report will comprise the following sections:

    a. **Design & Implementation [Hardware 15 marks, Firmware 15 marks]:** Hardware and Firmware document the design process in writing. Implement the design running on the PIC microprocessor in the lab. All relevant input/output interfaces need to be implemented. Your code must be uploaded to the module web and all implementation decisions need to be described. The use of digital photographs and screenshots of the hardware/software set-up is permitted as part of your explanation of the implementation. Proteus simulation runs of key aspects of your design should be included.

    b. **Component selection / Cost analysis [Hardware 5 marks]:** used and provide a cost analysis. Identify component suppliers and provide the corresponding stock number order codes. Create a **B**ill **O**f **M**aterials (BOM) list using Proteus or other means. Make sure that your components are ROHS compliant. Consider the environmental implications and health and safety issues that some of your design components might have.

    c. **Software Flowchart [Firmware 5 marks].** Firmware to develop a integration level flowchart to facilitate and help in the development of the overall firmware program.

    d. **Working Prototype build [Hardware 15 marks, Firmware 15 marks]:** A prototype has to be build and it must be able to demonstrate the intended application of this robotic vehicle to navigate, sense and make decision during the demo. Document the prototype build in your report.

    e. **Hardware Modular Testing & Firmware modular Testing / Simulation [Hardware 10 marks, Firmware 10 marks]** Independent verification of hardware and firmware/simulation to ensure that it is working before the actual integrated testing.

    f. **Integrated Testing / Validation [15 marks]**. Document the test methodology that you have followed for your design. This must describe what tests you decided to do and why you decided to make them. You also need to document calibration procedures, debugging issues and corresponding test results. **[15 marks]**

    g. **Teamwork [Individual contribution 10 marks each]**

    Emphasis is also given to evaluate the cohesiveness of the team, and able to demonstrate the ability to work together and able to discuss issues together to resolve project issues.

3. **Conclusions [7 marks]**. In your conclusions, you should survey the group's work and results and show how the task requirements were met. You should also survey the work, describing what went well and what did not. Go back and re-asses your original planning ideas. Discuss your findings.

Document the issues encountered and how you solve them. Highlight any issue that is not resolved for future work. Suggest future improvement to your design.

[Group report total 80 marks]

INDIVIDUAL MARK [10 marks]

Your **individual Electronic Portfolio (elogbook),** cannot be the same for each team member, document the journey of your learning, the knowledge learnt, the design consideration you had went through, with detail calculation or explanations, the decision make on your design, will be uploaded to Moodle through the link that will be provided. All laboratory activities should be discussed; solutions to tasks and fully commented software listings should also be included. All students should individually upload their personal Portfolio. The elogbook could be a scanned copy of your hardcopy log book that shows all your work done.

In-class Poster Presentation[10 marks]. Two (or more) assessors will evaluate your **individual contribution** to the work to check that it meets the objectives. This will be your group's presentation of your assignment. Each group member will be individually assessed.

The **Group report** need to be uploaded through Moodle to Turnitin via the link that will be provided. **Only One Report per group** to be uploaded by one group member. The other group members should upload a cover sheet that will be available via Moodle. Your uploaded project report naming should include your group name on its title (see point 6 in tasks above).

Your lab groups will be as defined at the start of the assignment session and cannot be changed. Groups are expected to work in pre-allocated bench areas.

You need to attend these classes promptly and follow laboratory health and safety rules.

Classes will be supervised by a lecturer/tutor, and colleagues.

Keep a safe copy of all coursework submitted for reference.

Components provided and development board:

Sharp Proximity sensor

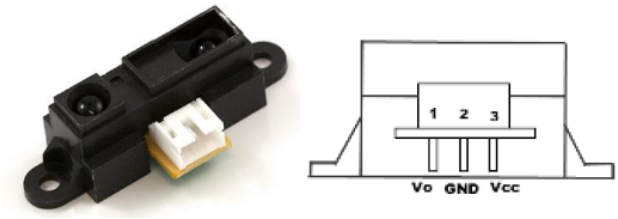
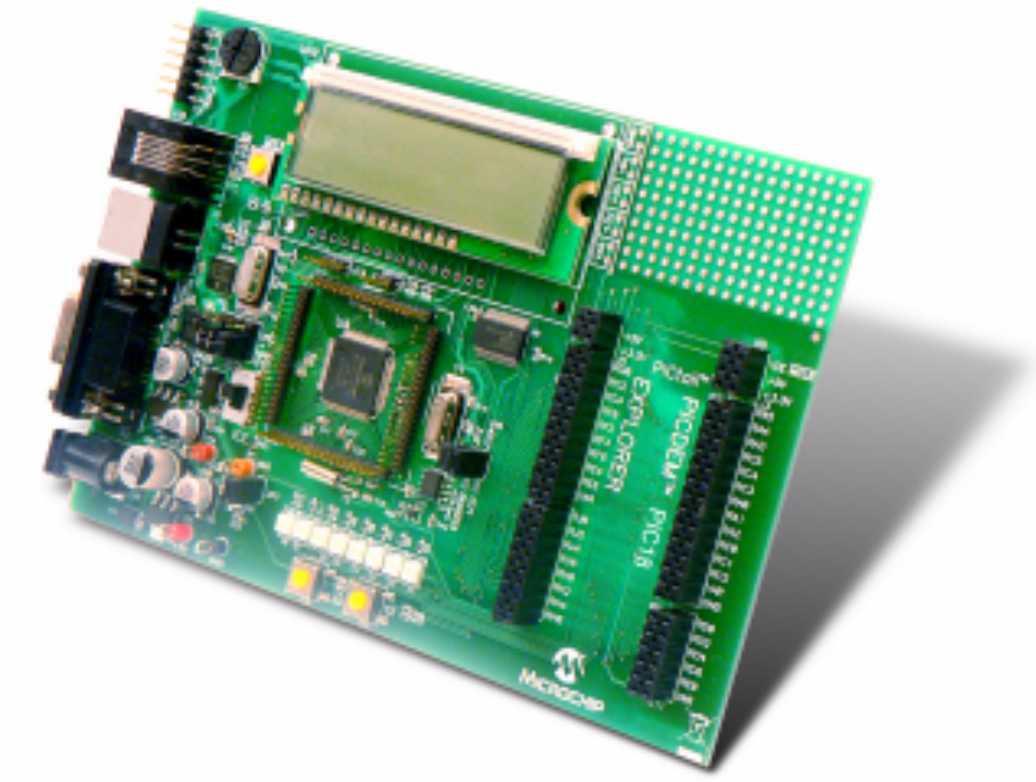


Photo-Reflective sensor

PICKIT 3 interface MPLAB, XIDE to the PIC18F development board



PIC18 Development Board

Please observe component handling and appropriate supply connections. Refer to the data sheets provided in previous sessions.

Please Do Not pull component and connecting leads by the connecting wires as this causes breakages, only use the solid part of the connector to remove these devices.

The only components using the 11 volt supply are the Regulator the Darlington driver's protection pin (10) and Stepper motors Vmotor connector.

All other components require a 5 volt supply.

Take care when connecting the battery to the vehicle. Shorting the battery leads can cause fire or injuries.

Please consult the appropriate datasheets for connection info and component parameters.

Note: it is **very important** that the work submitted is an individual effort. The penalties for plagiarism are severe.

The Faculty Policy on Assessed Coursework applies to this coursework. You are advised to read the guidelines available on the general Faculty CU online web site.

Keep a safe copy of all coursework submitted for reference.

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