ELECTRICAL ENGINEERING DEPARTMENT

POLITEKNIK PORT DICKSON

DET DEP DTK DEG DEQ

CDIO : INTEGRATED LEARNING EXPERIENCE

SEMESTER 4

DEE40082 –PROJECT 1

DEC50122 –EMBEDDED ROBOTIC

Electrical Engineering Department

DET DEP DTK DEG DEQ

de

CDIO : INTEGRATED LEARNING EXPERIENCE

POLITEKNIK MALAYSIA

PORT DICKSON

ACKNOWLEDGEMENT

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DEE40082- PROJECT 1

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DEC50122 - EMBEDDED ROBOTIC

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Published by:

Politeknik Port Dickson

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August 2020

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FOREWORD

First of all, be grateful to Allah s.w.t for his blessing and permission, then this e-book will be created. Congratulations to everyone all involved in the CDIO: Integrated Learning Experience electronic book's success and development. Indeed, the production of this e-book can be used as a reference and guidance for lecturers at Port Dickson Polytechnic's Department of Electrical Engineering.

The content of this e-book mainly contributed by materials that are normally used for the implementation of the courses involved in the integrated learning such as Notes of Guidance (NOG), course outline and assessment rubrics. The top management of polytechnic give their full support to this e-book publication as this initiative benefits to lectures and students. To meet the challenges of the education system and make digital learning is a new norm in the Covid19 pandemic situation. It becomes a starting point done to produce material in the form of e-books.

It is hoped that with this e-book, will be able to provide encouragement and guidance to the lecturers involved as well as the student while implementing the CDIO program to achieve the KPIs required by the department or polytechnic. In addition, it can provide process guidance before, during and after a program is implemented. Hopefully, by sharing a little information, CDIO operations may be conducted according to the department's planned implementation time.

Thank you

INTEGRATED LEARNING EXPERIENCE

INTRODUCTION

Electrical Engineering Department (JKE) integrates two courses to produce one common mini project involving semester 4 students of all five programmes in this department. This Intra-Program Integrated Learning Experience, integrates learning outcomes which infuses the CDIO skill sets of the 21st century skills.

JKE implemented Component 2 of CDIO by selecting courses that has project or mini project assessment in its syllabus. From all programmes curriculum in semester 4 and 5, three courses namely DEC50122 Embedded Robotic, DEE40082 Project 1, and DEC40053 Embedded System Application have project or mini project in course assessment. In DEC 2018 session, JKE integrates DEE40082 Project 1 and DEC40053 Embedded System Application. Due to current technology requirement, DEE40082 Project 1 and DEC50122 Embedded Robotic have been chosen for JKE integrated learning.

	PROGRAMME					NOTES
COURSES WITH MINI PROJECT ASSESSMENT	**DET**	**DEP**	**DTK**	**DEG**	**DEQ**	
DEC40053 EMBEDDED SYSTEM APPLICATIONS	√	√	√	√	√	• **Apply PIC microcontroller knowledge in Mini Project** • Software (MPlab for programming & proteus for simulation) • Kos RM 00.00
DEC50122 EMBEDDED ROBOTIC	√	√	√	√	√	• **Apply ARDUINO UNO microcontroller knowledge in Mini Project** • Hardware • Cost approx RM 100.00 / set
DEE40082 PROJECT 1	√	√	√	√	√	• **Construct electric / electronic circuit board** • Hardware / Software • Kos RM 50.00 / set

INTEGRATED LEARNING EXPERIENCE

OBJECTIVES

1. To develop students understanding in 21st Century Learning Skills through the experience in project collaboration and relate polytechnic learning environment with their future work-place.
2. To achieve two learning outcome of two different courses by developing one common project.
3. To contribute to JKE's KPI 17. *(KPI 17 - Bilangan program pengajian yang menggunakan kurikulum bersepadu (integrated curriculum) melalui kerangka Conceive, Design, Implement and Operate (CDIO))*

IMPACT

1. Students can save on the cost of purchasing project materials.
2. Student can use the outcome of DEE40082 mini project as one of DEC50122 mini project required device.
3. Student know the relationship of course learning outcome (CLO3 Practical Skills) of both DEE40082 and DEC50122.
4. Students can save their time preparing and implementing mini project for both courses DEE40082 and DEC50122.

COURSE MAPPING

Item	DEE40082 Project 1	DEC50122 Embedded Robotic
Student	DET4, DEP4, DTK4, DEG4, DEQ4	DET4, DEP4, DTK4, DEG4, DEQ4
Assessment Task (Marks %)	Mini Project Construction (35%)	Mini Project (10%)
Project activity	Construct relay circuit board	Apply relay circuit board from Project 1
Topic	4.0 Procedure to construct project hardware	1.0 Introduction to Robotic Controller 2.0 Sensors and Actuators 3.0 Mobile Robot Design 4.0 Mobile Robot Application
Related CLOs for project assessment	CLO3 (Psychomotor)	CLO1 (cognitive) CLO2 (cognitive) CLO3 (psychomotor) CLO4 (affective)
CLO for integration	CLO3	CLO3
Project period to assess CLO3	Week 2 to Week 7	Week 7 to Week 14

COURSE MAPPING

Courses	Topic	Assessment	Related CLOs	Assessment Question & Rubric
DEE40082 Project 1	4.0 Procedure to construct project hardware	Mini Project Construction 35%	CLO3: Perform project construction procedures (hardware project) or produce flowchart and draft algorithm for system programme (software project) and record the progress systematically in a logbook (P4, PLO5)	CLO3 Practical Skills Rubric 1. Student should be able to use proper simulation techniques and produce correct simulation results/ displays successfully 2. Student should high ability to produce perfect track size, track distance, pad size, footprints selection and placement and PCB layout size 3. Student able to produce PCB using proper techniques very well 4. Student have high ability to properly handle the soldering and desoldering tools. Solder is shiny and in proper size 5. Students able to use proper tools and techniques for component and circuit testing successfully
DEC50122 Embedded Robotic	1.0 Introduction to Robotic Controller 2.0 Sensors and Actuators 3.0 Mobile Robot Design 4.0 Mobile Robot Application	Mini Project 10%	CLO1: Investigate the concept and fundamentals of mobile robotic, embedded controller, sensors and actuators based on land mobile robot design (C4, PLO 4)	CLO1 Question
			CLO2: Design the concept of robot positioning, identification and communication in mobile robot control according to a standard robot organization regulation (C6, PLO 3)	CLO2 Question
			CLO3: Demonstrate an understanding of PLC environmentally-friendly automation system norm by following PLC IEC standard during practical work session (P4, PLO 5)	CLO3 Practical Skills Rubric 1. Able to upload programming code from Arduino IDE to Arduino Uno. 2. Able to configure or connect components (Sensor and Actuator) to the Microcontroller according to programming code. 3. Able to test the sensor functionality 4. Able to test the actuator functionality 5. Robot function according to strategy
			CLO4: Demonstrate good ability in managing a well-defined engineering-based project in a cost effective manner (A3, PLO11)	CLO4 Generic Skills Rubric 1. Completes tasks ahead of schedule by creating a plan and scheduling time to complete the work. 2. Able to make a very good decision based on excellent understanding of the situation and available options 3. Deliver ideas with excellent clarity, comprehensive and organization 4. Work was divided excellently amongst group members 5. Very high motivation to complete task

IMPLEMENTATION

Item	DEE40082 Project 1	DEC50122 Embedded Robotic
Student	Individual (1 student construct 1 circuit board)	Individual (1 student configure 1 mini project)
Task	Simulation (week 2-3) PCB development (week 4-7)	a. Mobile robot design (week 7-13) b. Interfacing (week 14)
Assessment	Week 7	Week 14

IMPLEMENTATION

DEE40082 Mini Project

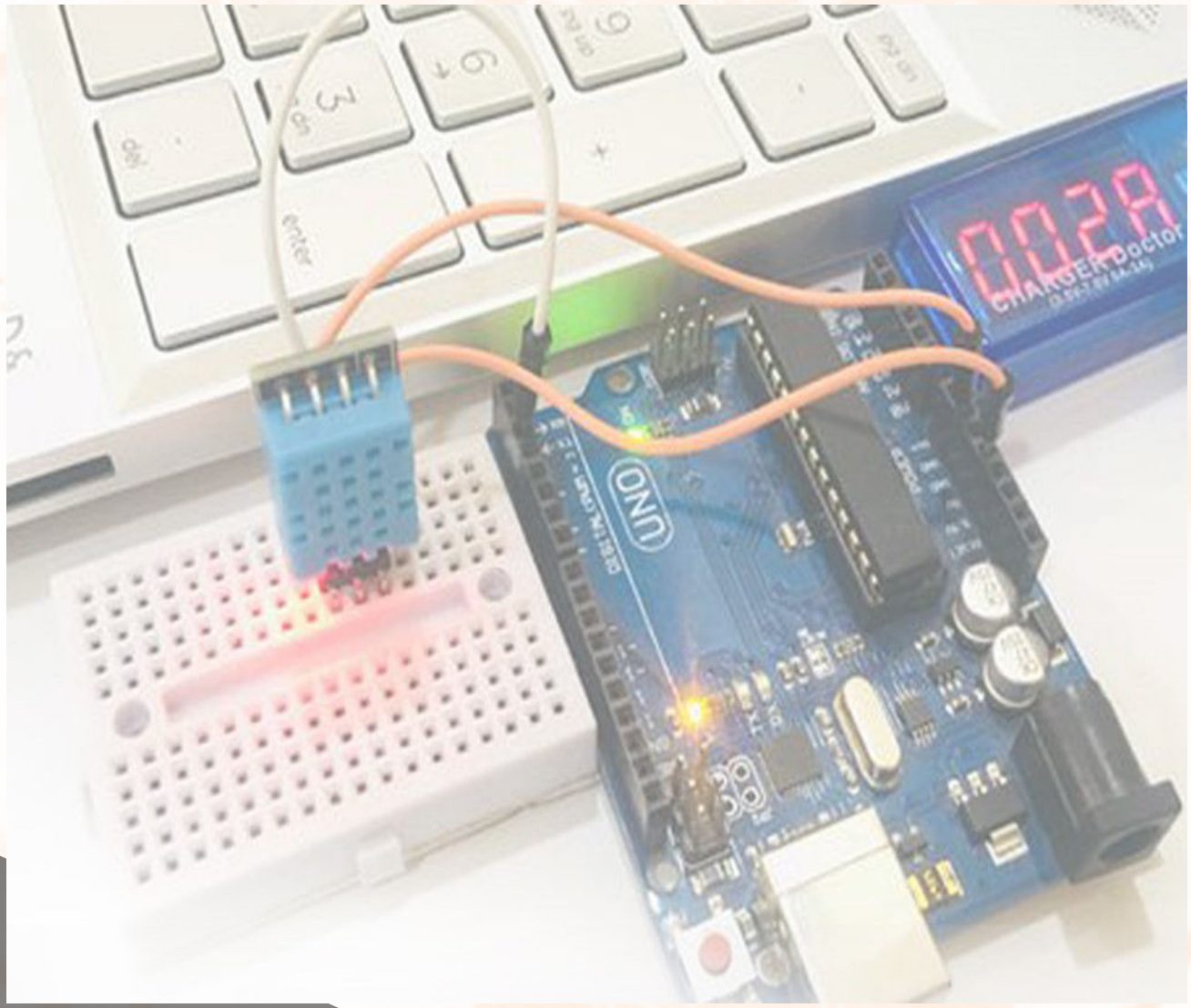
Perform project construction procedure for electric / electronic circuit board (CLO3)

DEC50122 Mini Project

Manipulate the application of sensor and actuators (CLO3)

NOTES OF GUIDANCE

DEE40082 PROJECT 1



SEMESTER 4

DEE40082 –PROJECT 1

DEC50122 –EMBEDDED ROBOTIC

NOG – DEE40082 Introduction

In DEE40082, students use Proteus Simulation Software to draw schematic circuit. Students are then simulating the circuit to determine weather the circuit is correct and can produce result successfully.

Students will convert the schematic circuit into printed circuit board (PCB) design layout. In this task they learn how to produce perfect track size, track distance, pad size, footprints selection and placement and PCB layout size.

Once the tasks completed, students will transfer their PCB design layout onto PCB board using proper technique such as etching method. Then, components placement is done by using correct soldering tools and techniques. Students will do component and circuit testing by using proper testing instrument.

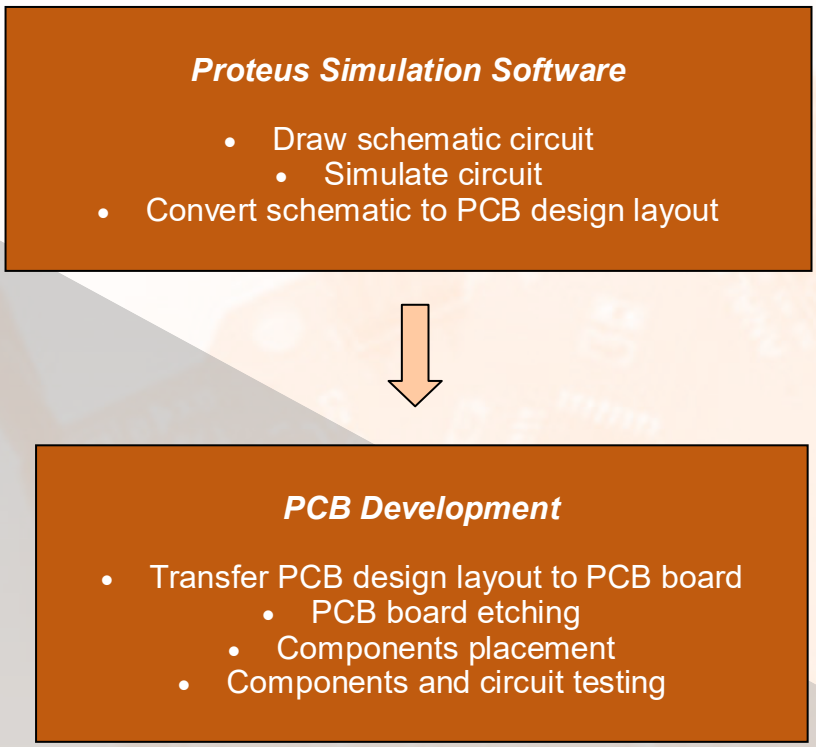


Figure 1: Mini Project circuit board construction process

NOG – DEE40082 Mini project circuit

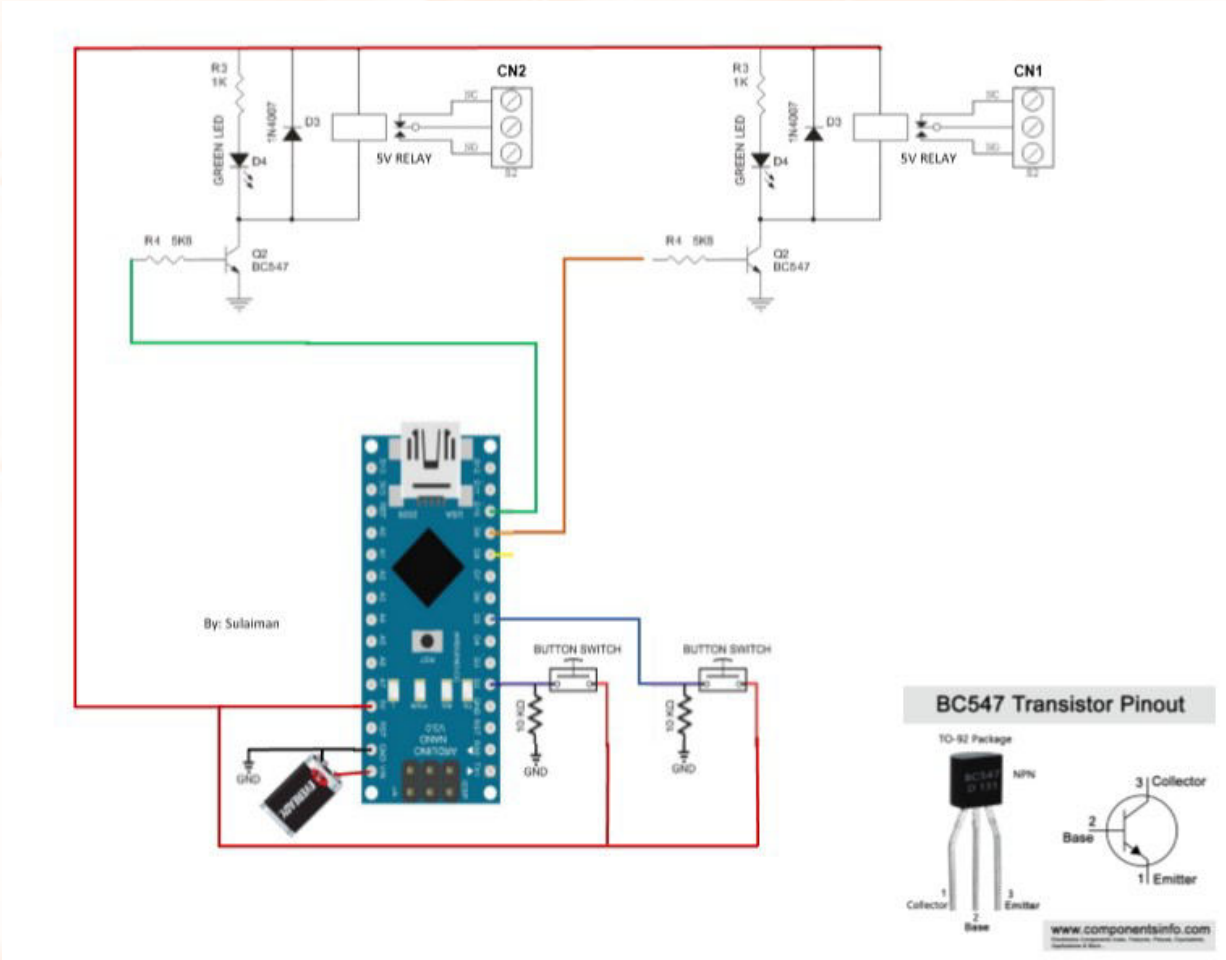
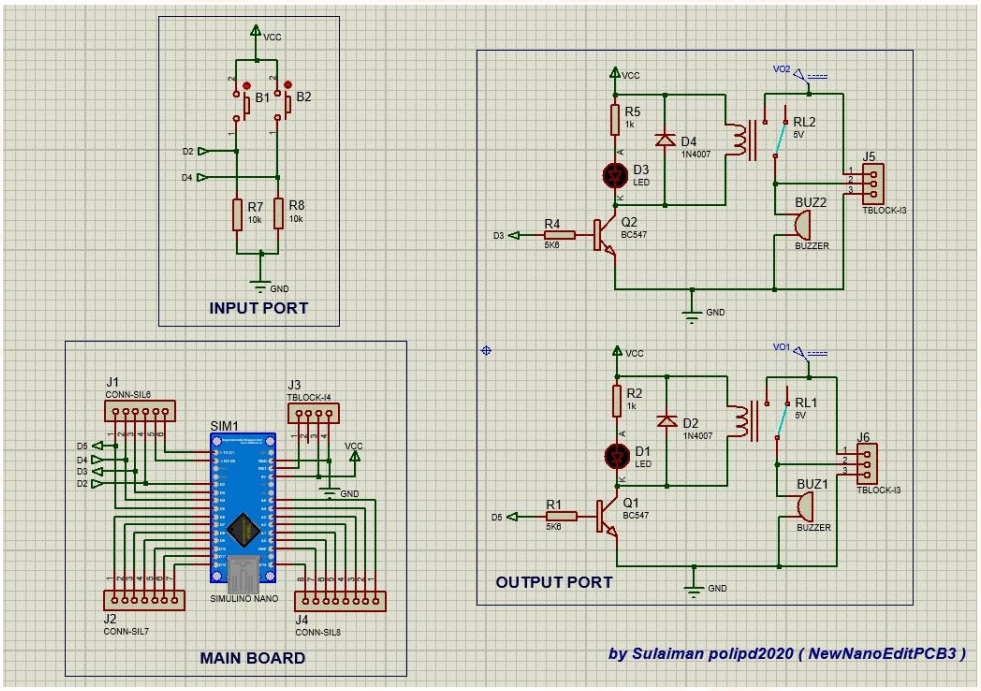


Figure 2(a): Mini project schematic circuit (example)

NOG – DEE40082 Mini project circuit



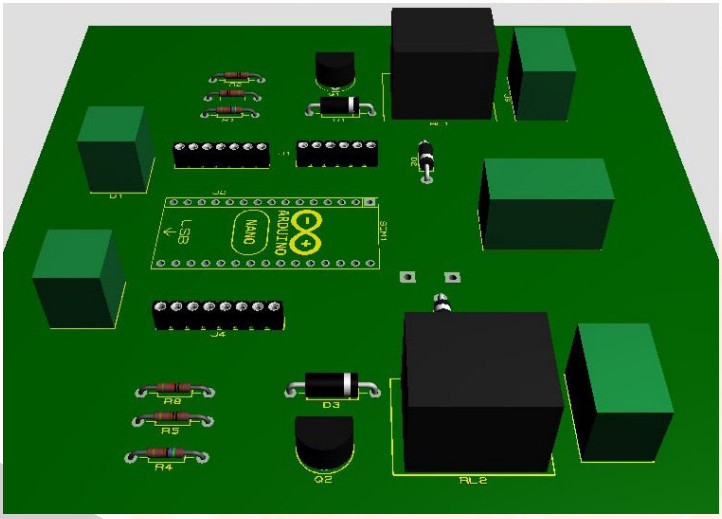
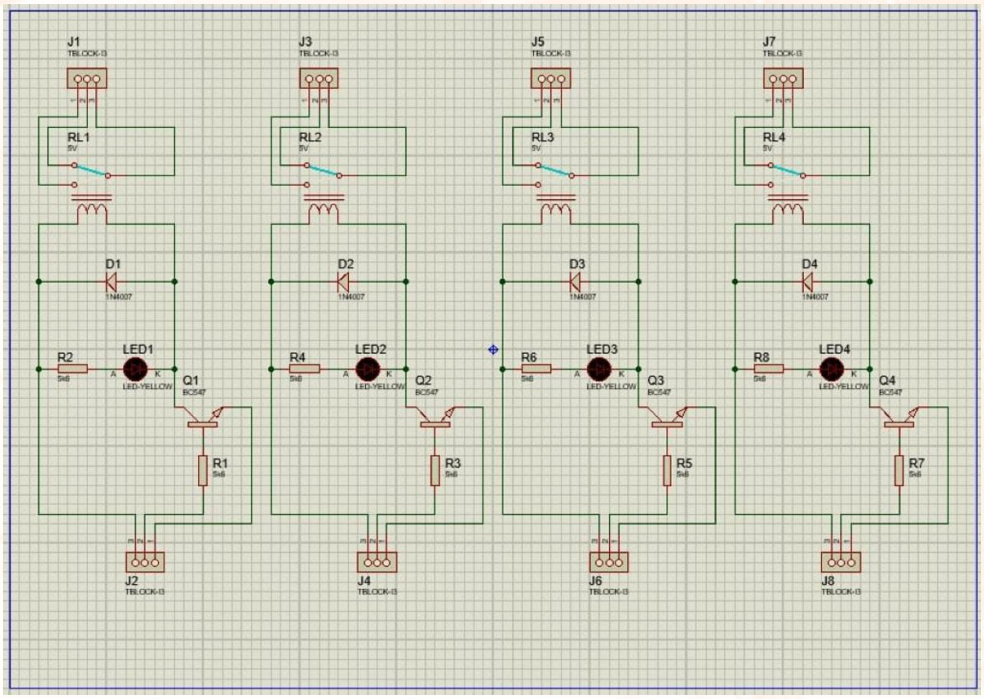


Figure 2(b): Mini project schematic circuit and its 3D visualization (example)

NOG – DEE40082 Mini project circuit



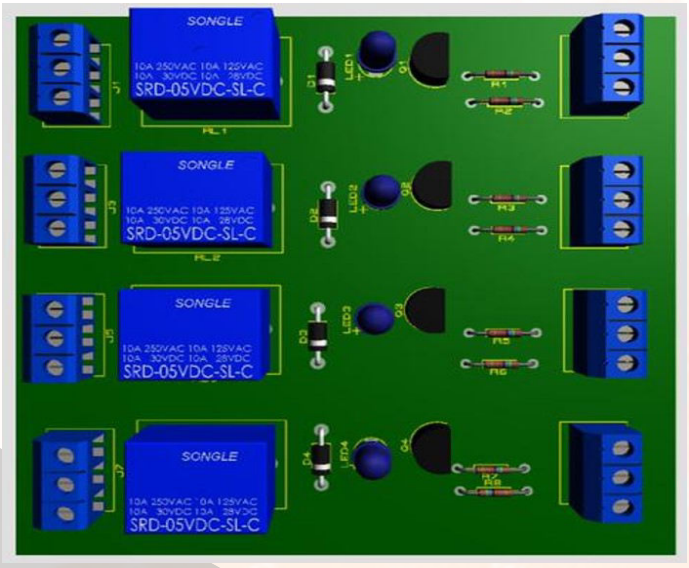
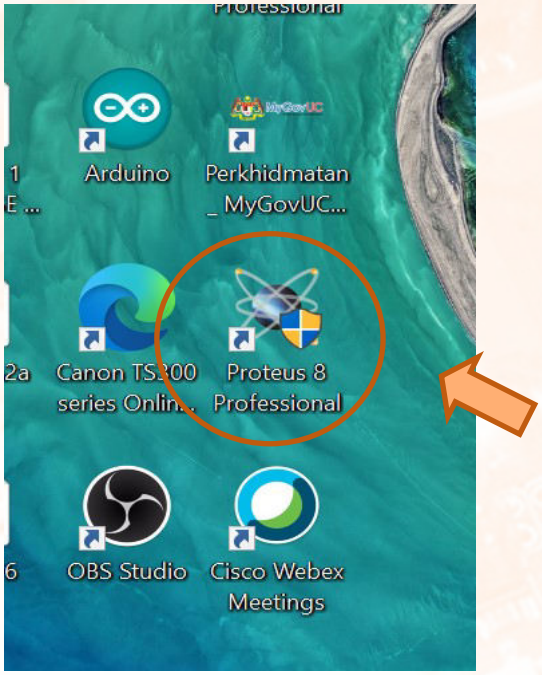


Figure 2(c): Mini project schematic circuit and its 3D visualization (example)

NOG – DEE40082 Procedure

1. Get the schematic circuit of mini project.
2. Install Proteus simulation software.
3. Produce schematic circuit diagram using Proteus simulation software
4. Run the simulation of the schematic circuit.
5. Produce printed circuit board (PCB) design layout.
6. Produce PCB using etching or CNC miling.
7. Test each components.
8. Place components on the circuit board.
9. Solder the components using correct techniques.
10. Check circuit connection.
11. Test the circuit board using correct tools.

NOG—DEE40082 Simulation Software



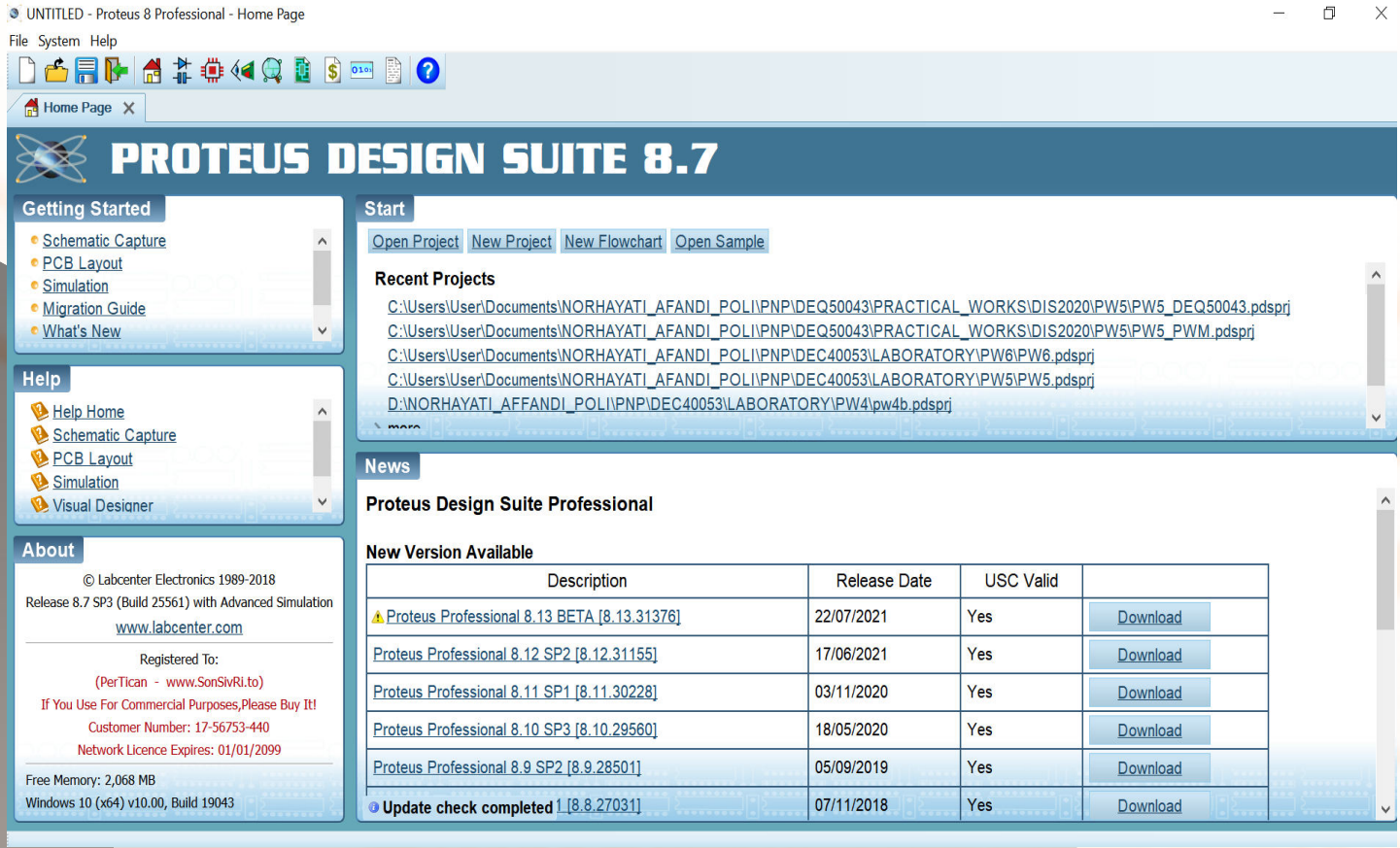


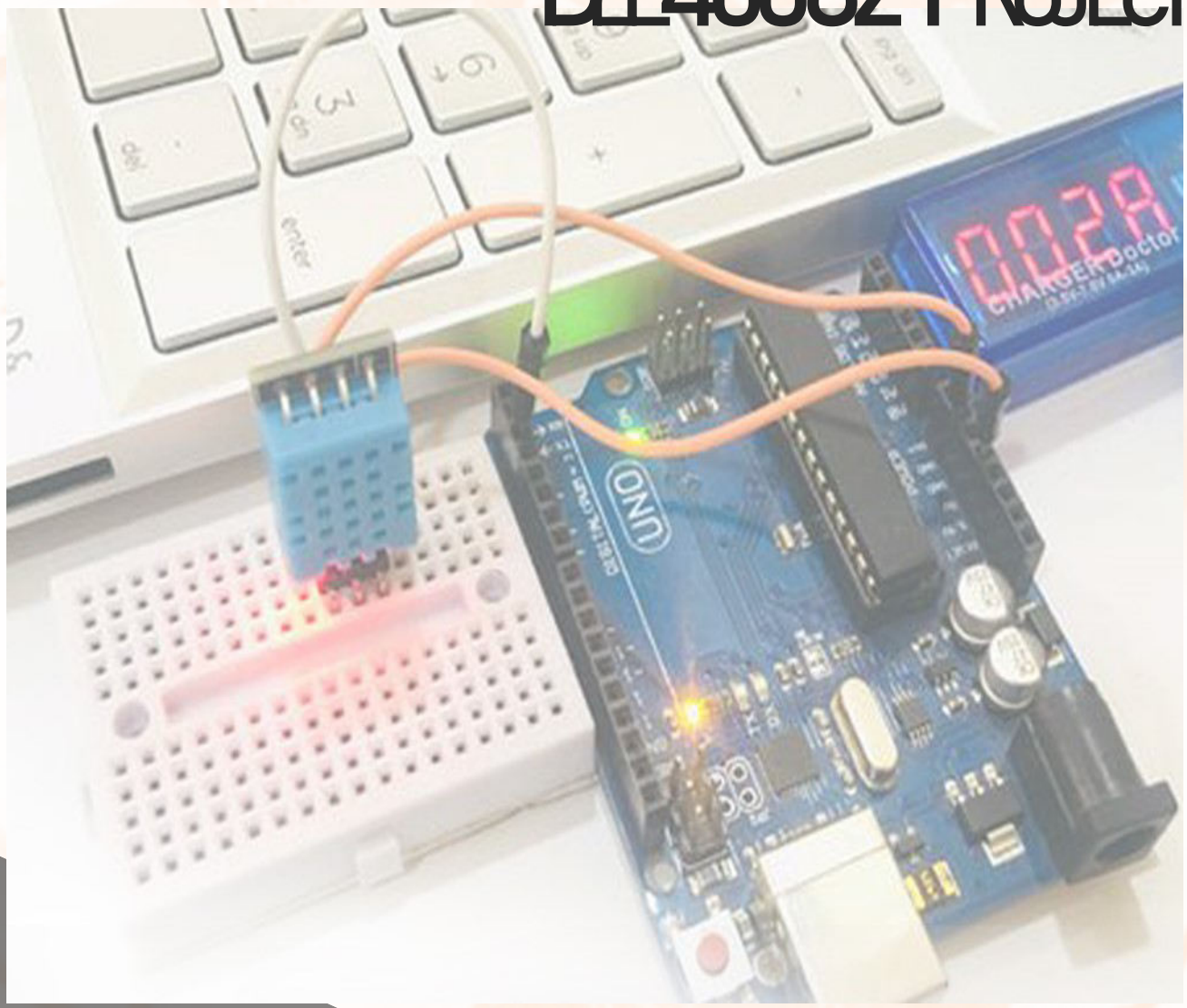
Figure 3: Simulation software used for DEE40082 mini project development

NOG— DEE40082 Hardware Development

Figure 4: Activities in mini project hardware development

PROJECT BRIEF

DEE40082 PROJECT 1



SEMESTER 4

DEE40082 –PROJECT 1

DEC50122 –EMBEDDED ROBOTIC

PROJECT BRIEF – COURSE OUTLINE

KEMENTERIAN PENGAJIAN TINGGI

POLITEKNIK MALAYSIA PORT DICKSON

COURSE OUTLINE
SESSION DEC 2020

DEE40082 – PROJECT 1

Credit(s) : **2**
Duration : **Lecture – 14 hours, Practical – 28 hours**
Prerequisite(s) : **None**

1.0 SYNOPSIS

PROJECT 1 provides knowledge regarding the implementation and development methods of a project based on hardware or software or a combination of hardware and software. This course provides exposure to the project management and finance, techniques to develop project and proposal preparation. The students are allowed to do an individual or group project but will be assessed individually through the project assessment tasks throughout the course.

2.0 PROGRAMME EDUCATIONAL OBJECTIVES (PEO) (3-5 years after graduated)

The engineering programme should produce balanced TVET graduates who are:

PEO1: practicing technician in electrical engineering related field
PEO2: contributing to society with professional ethic and responsibilities
PEO3: engaging in enterprising activities that apply engineering knowledge and technical skills
PEO4: engaging in activities to enhance knowledge for successful career advancement

3.0 LEARNING OUTCOMES

Upon completion of this course, students should be able to:

No.	Course Learning Outcome (CLO)	PROGRAMME OUTCOME (PO) ETAC	Cluster (CLS)
1.	Investigate well defined problem in order to make improvements on a chosen project **(C4, PLO4)**	PLO4 **Investigation**	CLS2 **Cognitive Skills**
2.	Evaluate engineering problem and conduct research in order to make improvements on a chosen project whether the project is on the hardware, software or hardware-software interface type **(C5, PLO 2)**	PLO2 **Problem Analysis**	CLS2 **Cognitive Skills**
3.	Perform project construction procedures (hardware project) or produce flowchart and draft algorithm for system programme (software project) and record the progress systematically in a logbook **(P4, PLO5)**	PLO5 **Modern Tool Usage**	CLS3a, CLS3c **Practical Skills, Digital & Numeracy Skills**
4.	Display good project management and finance through a Gantt Chart (milestone) and final proposal **(A3, PLO11)**	PLO11 **Project Management and Finance**	CLS4 **Personal & Entrepreneurial Skill**
5.	Demonstrate continuous learning, information management and independent acquisition of new knowledge and skill to support the development of the project through the final proposal development of the project through the finalproposal **(A3, PLO 12)**	PLO12 **Lifelong Learning**	CLS4 **Personal & Entrepreneurial Skill**
6.	Display written communication skill through a final proposal **(A3, PLO10)**	PLO10 **Communication**	CLS3b **Interpersonal & Communication Skills**
7.	Describe the impact of the proposed project to the society in the final proposal **(A3, PLO6)**	PLO6 **The Engineer and Society**	CLS3b **Interpersonal & Communication Skills**

4.0 TEACHING METHODOLOGY

Project activity, Discussion, Self-directed learning.

5.0 WEEKLY LECTURE SCHEDULE

WEEK	DATE	COURSE CONTENT OUTLINE
Week 1 (1 hour)	**8/3 – 14/3/2021**	Project briefing
Week 2 (1 hour)	**15/3 – 21/3/2021**	4.0 Procedures to construct project • Apply hardware based or software based or software-hardware interfacing project
Week 3 (1 hour)	**22/3 – 28/3/2021**	4.0 Procedures to construct project • Apply hardware based or software based or software-hardware interfacing project
Week 4 (1 hour)	**29/3 – 4/4/2021**	1.0 Project Selection • Identify problem
Week 5 (1 hour)	**5/4 – 11/4/2021**	1.0 Project Selection • Structuring problem
Week 6 (1 hour)	**12/4 – 18/4/2021**	1.0 Project Selection • Selecting project criteria (innovative / improvisation / problem solution)
Week 7 (1 hour)	**19/4 – 25/4/2021**	1.0 Project Selection • Choosing project category (hardware / software / hardware-software)
Week 8 (1 hour)	**26/4 – 2/5/2021**	2.0 Project Management • Understand project management • Project life cycle and phases
Week 9 (1 hour)	**3/5 – 9/5/2021**	2.0 Project Management • Project controlling and monitoring • Planning and scheduling (preparing target schedule – Gantt chart) 3.0 Investigation Report and Final Proposal Preparation • Project problem or opportunity • Scope and constraint
	10/5 – 16/5/2021	**SEMESTER BREAK**
Week 10 (1 hours)	**17/5 – 23/5/2021**	3.0 Investigation Report and Final Proposal Preparation • Carry out finding • Project usability, cost, benefits and schedule data
Week 11 (1 hours)	**24/5 – 30/5/2021**	3.0 Investigation Report and Final Proposal Preparation • Feasibility • Conclusion and recommendations
Week 12 (1 hour)	**31/5 – 6/6/2021**	3.0 Investigation Report and Final Proposal Preparation • Project introduction • Weekly activity and Gantt chart
Week 13 (1 hour)	**7/6 – 13/6/2021**	3.0 Investigation Report and Final Proposal Preparation • Project review • Methodology
Week 14 (1 hour)	**14/6 – 20/6/2021**	3.0 Investigation Report and Final Proposal Preparation • Finding and discussion • Conclusion and recommendation
		STUDY WEEK
		FINAL EXAMINATION
Total Theory hours = 14		

6.0 ASSESSMENT:

i. Continuous Assessment (CA) - 100%
ii. Final Examination (FE) / Final Assessment – None

No.	Assessment	CLO	Topic	Quantity	% Total	Due Date
1	Logbook a. Programming b. Circuit simulation, schematic circuit, PCB layout c. Etching, soldering, testing	CLO3	T4	1	35	**(LAMPIRAN A)**
2	Investigation Report	CLO1 CLO2	T1-T3	1	25	**(LAMPIRAN B)**
3	Final Proposal	CLO4 CLO5 CLO6 CLO7	T1-T3	1	40	W14
	Total Continuous Assessment % (CA)				**100 %**	
4	Final Examination	-	-	-	0	
	Total Final Assessment % (FA)				**0 %**	

7.0 PRACTICAL SCHEDULE

No.	Title	Hours	Week (SLT)	Implementation Date
1.	Mini Project construction	15	W1-W8	(refer to LAMPIRAN A)
2.	Project selection	1	W8	W5 (5/4 - 11/4/2021)
3.	Project management	1	W9	W4 (29/3 – 4/4/2021
4.	Investigation Report	4	W9-W11	W8-W9 (refer to LAMPIRAN B)
5.	Final Proposal	7	W11-W14	W9-W11 (refer to LAMPIRAN B)
	Total Practical hour	**28**		

8.0 STUDENT LEARNING TIME (SLT)

F2F	Hour	NF2F	Hour	
Lecture	12	Independent Learning	23	
Practical	22	Continuous Assessment	15	
Continuous Assessment	8			
Total SLT	**42**		**38**	**80**

9.0 REFERENCES:

Main reference supporting the course

Harald Kerzner. (2017) *Project Management: A Systems Approach To Planning, Scheduling, And Controlling.* United States of America. John Wiley & Sons

Additional references supporting the course

1. Charles Platt. (2013) *Encyclopedia of Electronic Components Vol. 1 : Power Sources &Conversion*.United States of America. O'Reilly Media. Inc
2. Charles Platt & Redrik Jansson. (2015) *Encyclopedia of Electronic Components Vol. 2: Signal Processing*. United

States of America. Maker Media. Inc
3. Charles Platt & Redrik Jansson. (2016) *Encyclopedia of Electronic Components Vol. 3: Sensor*. United States of America. Maker Media. Inc
4. Cornel Amariei. (2015) *Arduino Development Cookbook*. Birmingham, UK. Packt Publishing Ltd
5. Doug Lowe. (2017) *Electronics All in One or Dimmies, 2nd ed.United States of America*. John Wiley & Sons Inc
6. James A. Langbridge. (2015) *Arduino Sketches Tools and Techniques for Programming Wizardry*. United States of America. John Wiley & Sons Inc
7. Paul Scherz & Simon Monk. (2016) *Practical Electronics For Inventors*. 4th ed. United States of America. McGraw Hill Education

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Course Coordinator
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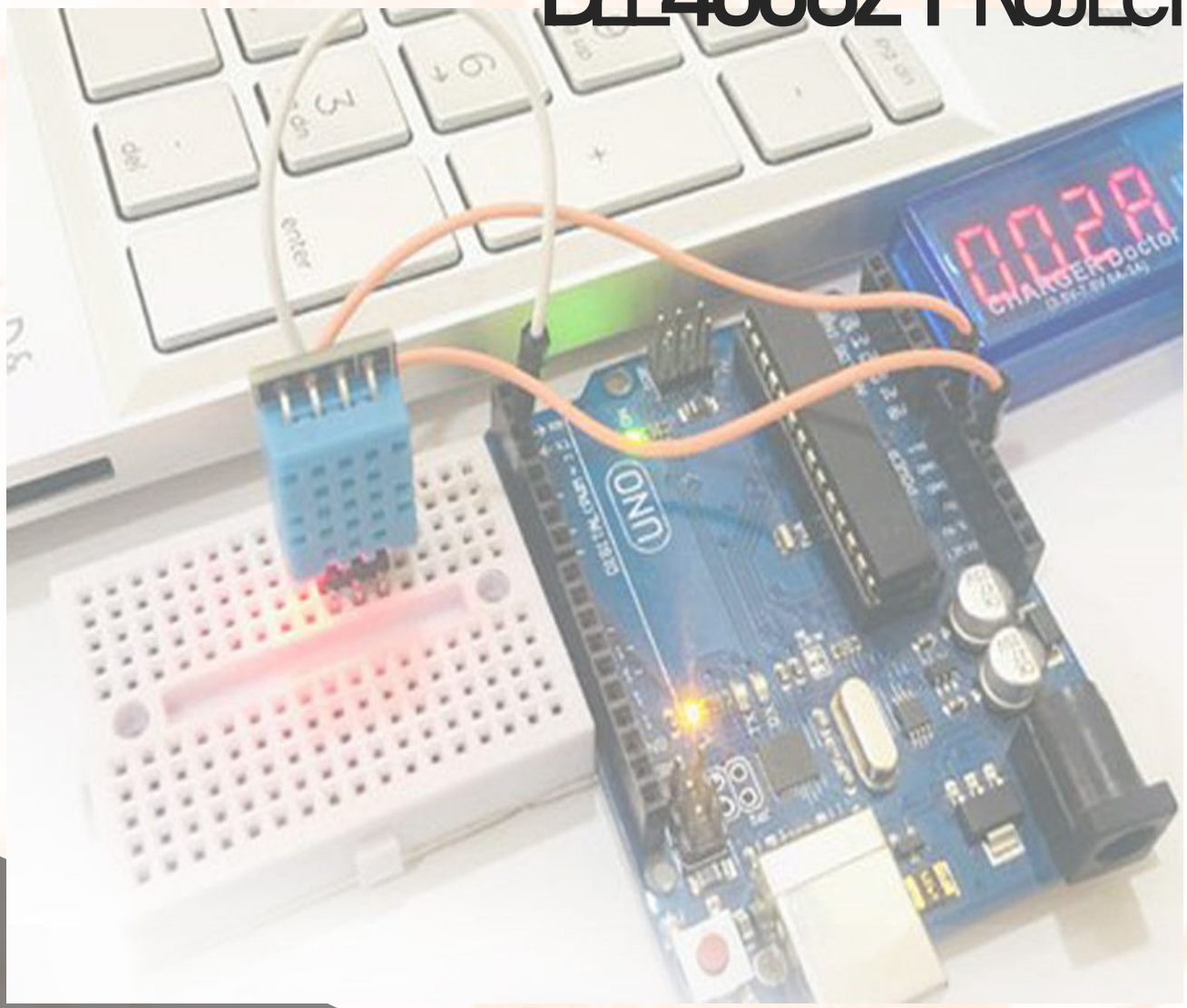
PLOMA KEJURUTERAAN ELEKTRIK (Tenaga Hij
JABATAN KEJURUTERAAN ELEKTRIK
POLITEKNIK PORT DICKSON

(NORLIE YUZZANA BINTI IBRAHIM)
Head of Programme (DEG)
Date: 8/3/21

PROJECT RUBRIC

DEE40082 PROJECT 1



SEMESTER 4

DEE40082 –PROJECT 1

DEC50122 –EMBEDDED ROBOTIC

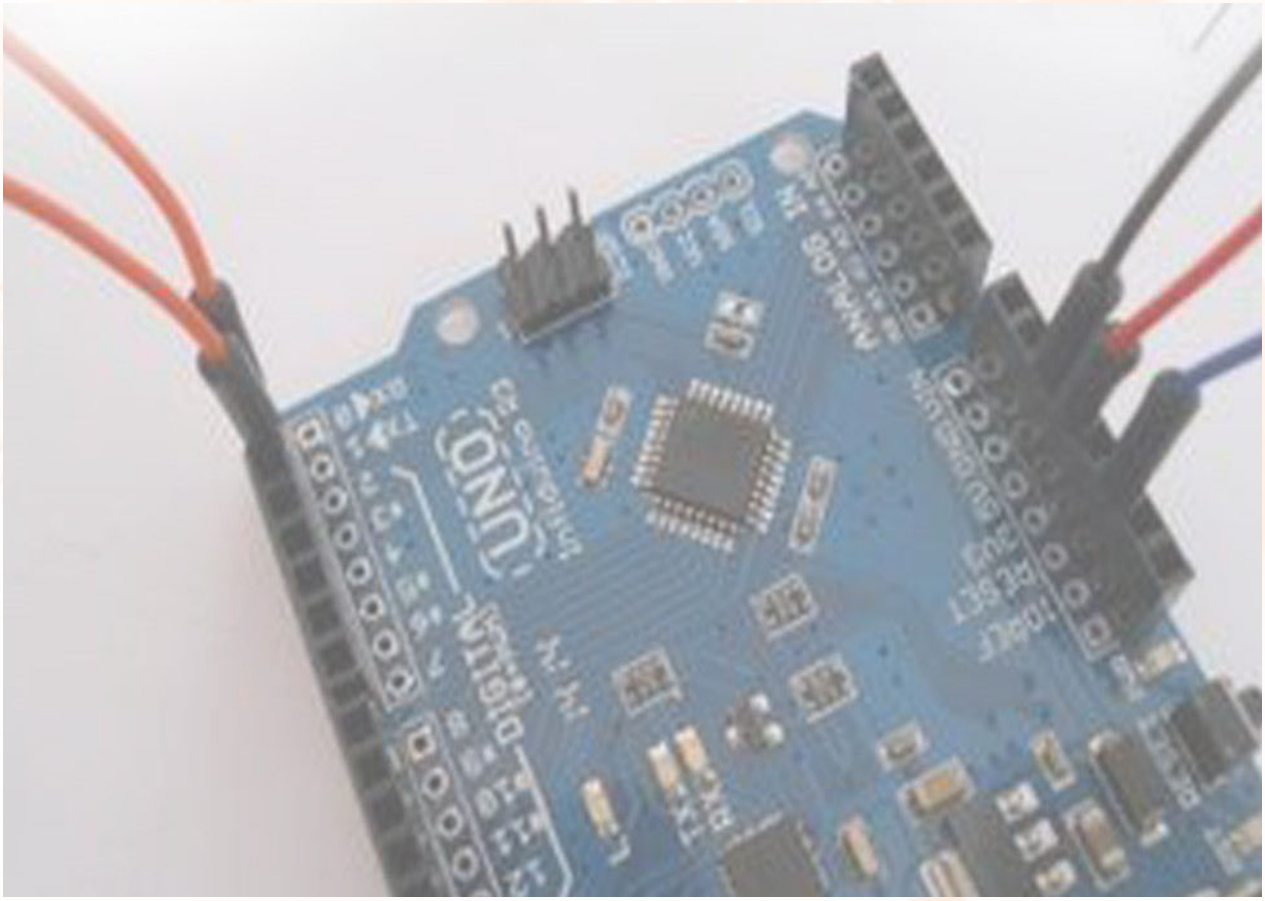
DEE40082 PRACTICAL SKILL RUBRIC

Department of Electrical Engineering
Log Book (Project Progress And Mini Project Construction) - DEE40082 PROJECT 1
Academic Session:

Student Name: Class:
Registration Number: Project Supervisor:
CLO / PLO: CLO3 / PLO5 / CLS3a,3c

Attribute	Rubric	Sub attribute	Very Weak (1)	Weak (2)	Fair (3)	Good (4)	Very Good (5)	Score
Project Progress	A.	Record weekly project activities	Not able to record weekly project activities	Able to record weekly project activities and require major improvement	Able to record weekly project activities and require minor improvement	Able to record weekly project activities clearly	Able to record completely weekly project activities with clearly and systematically	/ 5
	B.	Construct graphics/ tables/ diagrams/ flowchart/ algorithm/ programming/ coding	Not able to construct graphics/ tables/ diagrams/ flowchart/ algorithm/ programming/ coding	Able to construct graphics/ tables/ diagrams/ flowchart/ algorithm/ programming/ coding and require major improvement	Able to construct graphics/ tables/ diagrams/ flowchart/ algorithm/ programming/ coding and require minor improvement	Able to well construct graphics/ tables/ diagrams/ flowchart/ algorithm/ programming/ coding	Able to very well construct graphics/ tables/ diagrams/ flowchart/ algorithm/ programming/ coding	/ 5
	C.	Perform continuous project improvement based on feedback by supervisor	Not able to perform continuous project improvement based on feedback by supervisor	Able to perform continuous project improvement based on feedback by supervisor and require major improvement	Able to perform continuous project improvement based on feedback by supervisor and require minor improvement	Able to well perform continuous project improvement based on feedback by supervisor	Able to very well perform continuous project improvement based on feedback by supervisor	/ 5
Mini Project Construction	D.	Produce circuit schematic and circuit simulation	Not able to use proper simulation techniques and produce correct simulation results/ displays for most part of the project circuit.	Able to use proper simulation techniques and produce correct simulation results/ displays for most part of the project circuit and require major improvement	Able to use proper simulation techniques and produce correct simulation results/ displays for parts of the project circuit and require minor improvement	Able to use proper simulation techniques and produce correct simulation results/ displays for parts of the project circuit	Able to use proper simulation techniques and produce correct simulation results/ displays successfully	/ 5
	E.	Produce PCB design layout	Not able to produce proper track size, track distance, pad size, footprint selection and placement and PCB layout size	Able to produce proper track size, track distance, pad size, footprint selection and placement and PCB layout size and require major improvement	Able to produce proper and acceptable track size, track distance, pad size, footprint selection and placement and PCB layout size and require minor improvement	Ability to produce proper and acceptable track size, track distance, pad size, footprint selection and placement and PCB layout size	High ability to produce perfect track size, track distance, pad size, footprint selection and placement and PCB layout size	/ 5
	F.	Produce PCB using etching or CNC Milling	Not able to produce PCB using proper techniques	Able to produce PCB using proper techniques and require major improvement	Able to produce PCB using proper techniques and require minor improvement	Able to produce PCB using proper techniques well	Able to produce PCB using proper techniques very well	/ 5
	G.	Soldering tools and techniques	Not able to properly handle the soldering and desoldering tools. Produce many cold-joints and bulky solder	Able to properly handle the soldering and desoldering tools. Produce many cold-joints and bulky solder and require major improvement	Able to properly handle the soldering and desoldering tools. Produce a few cold-joint or bulky solder and require minor improvement	Able to properly handle the soldering and desoldering tools. Produce a few cold-joint or bulky solder	High ability to properly handle the soldering and desoldering tools. Solder is shiny and of proper size.	/ 5
	H.	Component and circuit testing	Not able to use proper tools and techniques for component and circuit testing	Able to use proper tools and techniques for component and circuit testing and require major improvement	Able to use proper tools and techniques for component and circuit testing and require minor improvement	Able to use proper tools and techniques for component and circuit testing	Able to use proper tools and techniques for component and circuit testing successfully	/ 5
							TOTAL	/ 40
							TOTAL ACTUAL	/35

NOTES OF GUIDANCE
DEC50122 EMBEDDED ROBOTIC



SEMESTER 4

DEE40082 –PROJECT 1

DEC50122 –EMBEDDED ROBOTIC

NOG– DEC50122 INTRODUCTION

In DEE50122, students are given a question that required them to design a mobile robot using ARDUINO-NANO microcontroller interface to several input output devices. In the design task, students plan all possible movements and actions for their mobile robot. Then students are needed to write a programme of the design on ARDUINO IDE platform, simulate and analyze the process of robot communication.

The program will be uploaded onto ARDUINO-NANO microcontroller based robot, connect all input output devices and test the functionality.

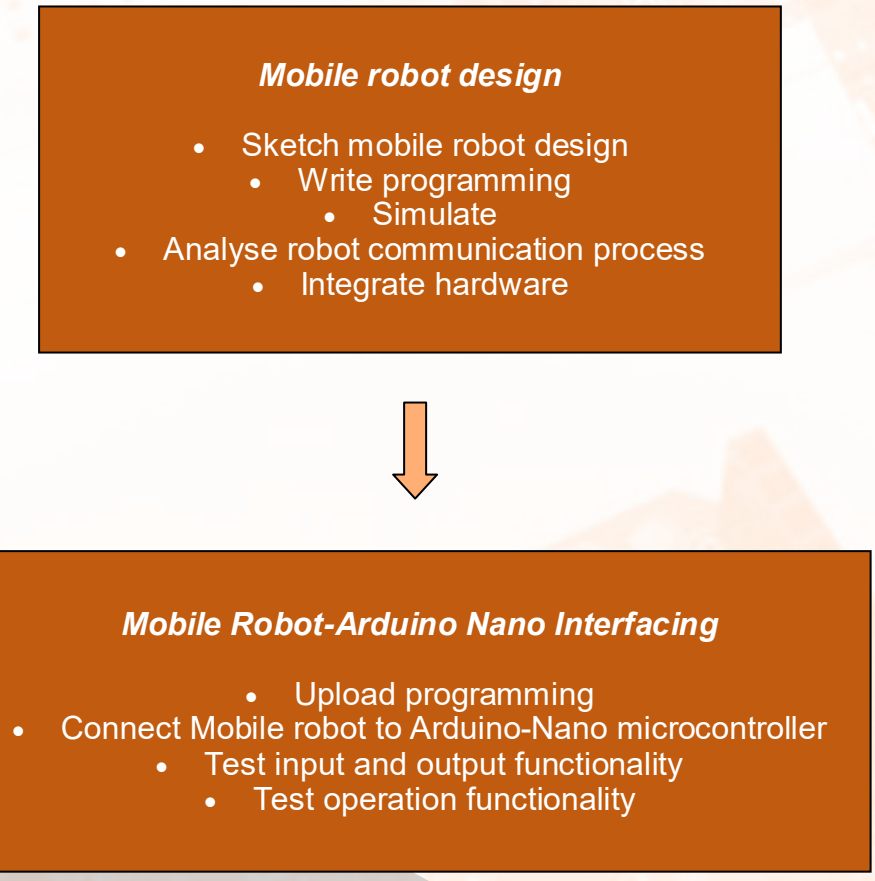
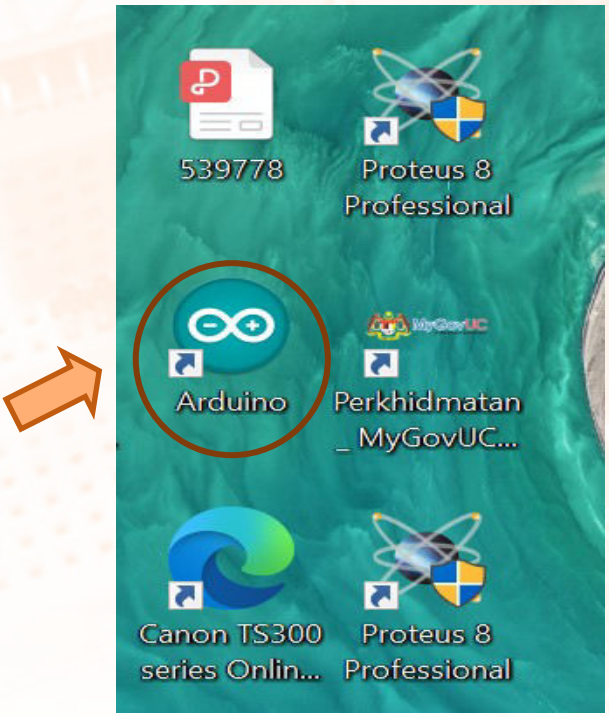


Figure 5: Mobile robot design and ARDUINO-UNO interfacing process

NOG- DEC50122 PROCEDURE

1. Students are required to build a SUMO Robot for mini Project.
2. Sketch the design of the SUMO Robot.
3. Write the programming code for your SUMO Robot in Arduino ide programming software.
4. Simulate and upload your Arduino sketch to the SUMO Robot that have designed.
5. Analyze your SUMO Robot communication process (autonomous / wireless / Bluetooth/2.4Ghz).
6. Integrate all components, hardware, sensor and software for the SUMO Robot.
7. Test run the SUMO Robot after completed configuration.

NOG- DEC50122 SIMULATION SOFTWARE



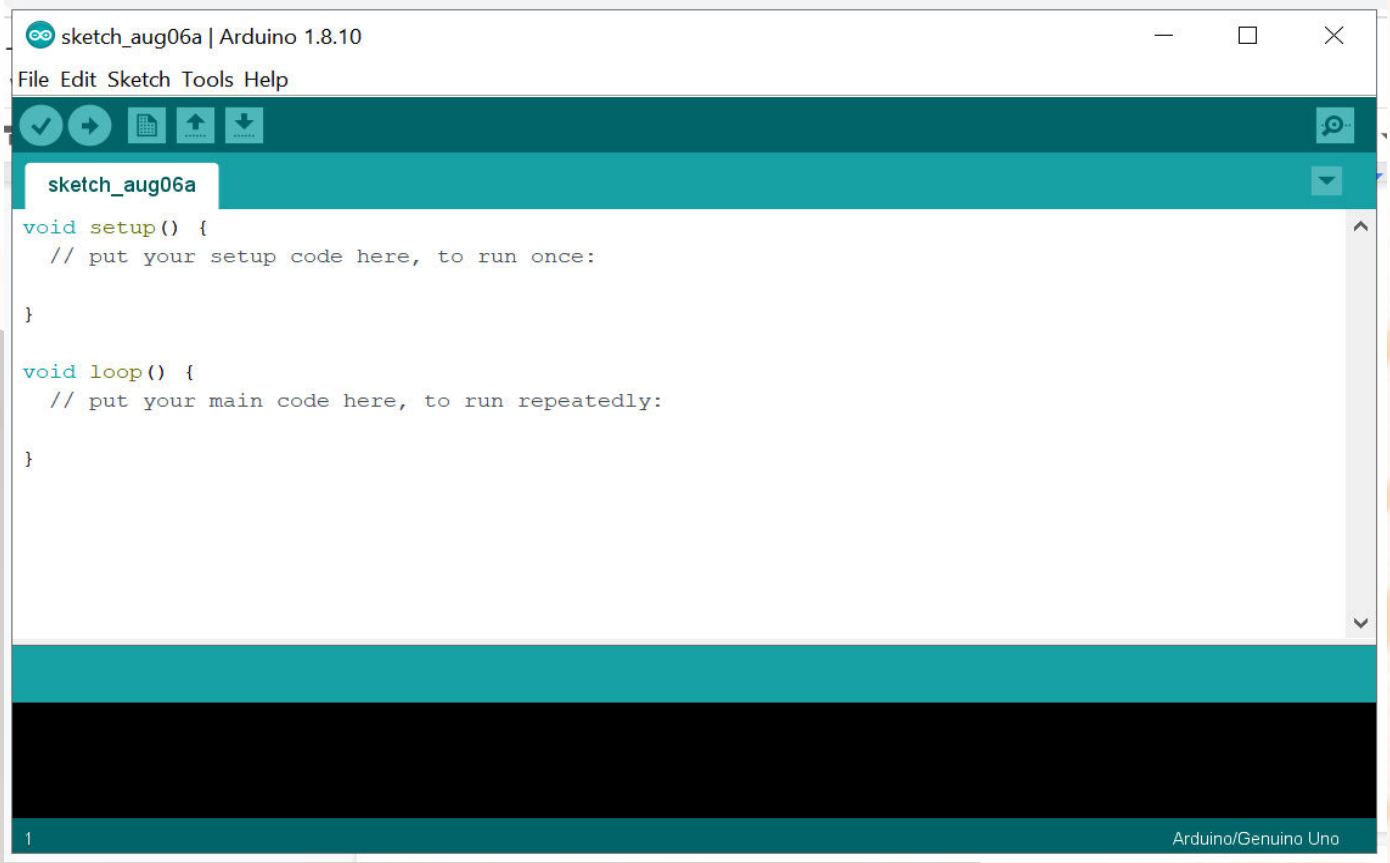
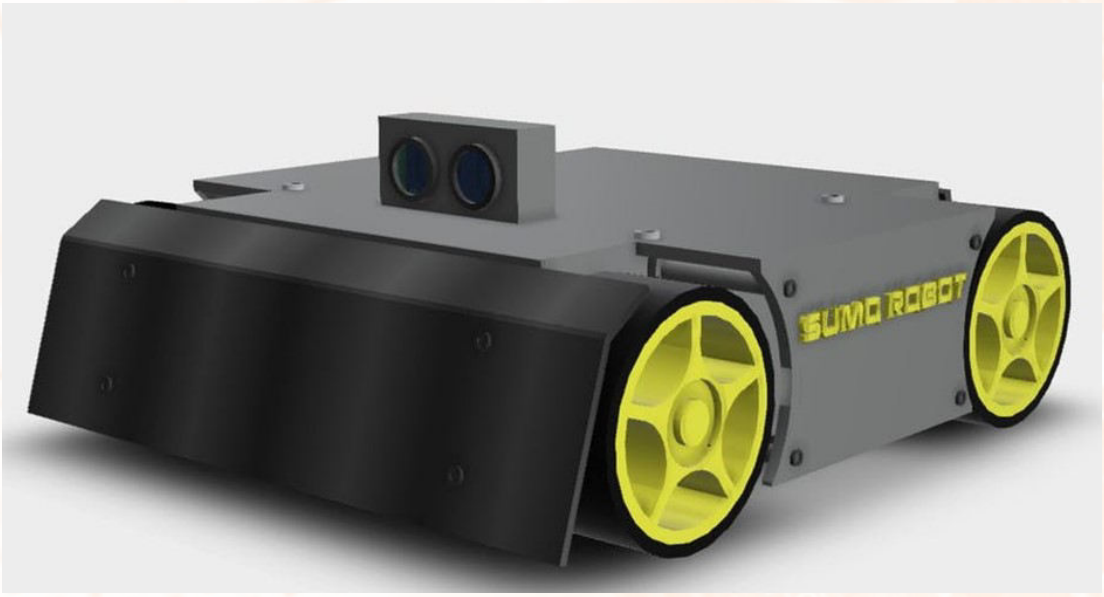


Figure 6: Arduino IDE simulation software used for DEC50122 mini project development

NOG– DEC50122 HARDWARE CONFIGURATION



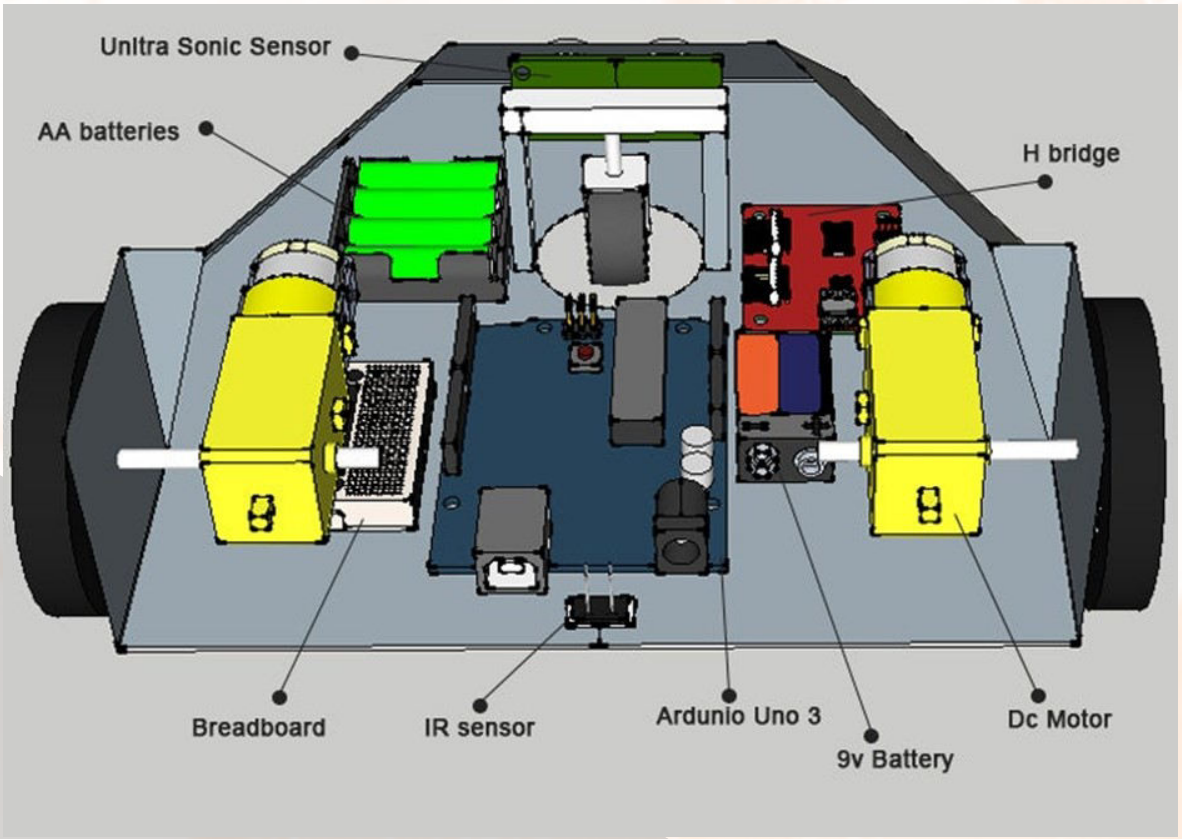
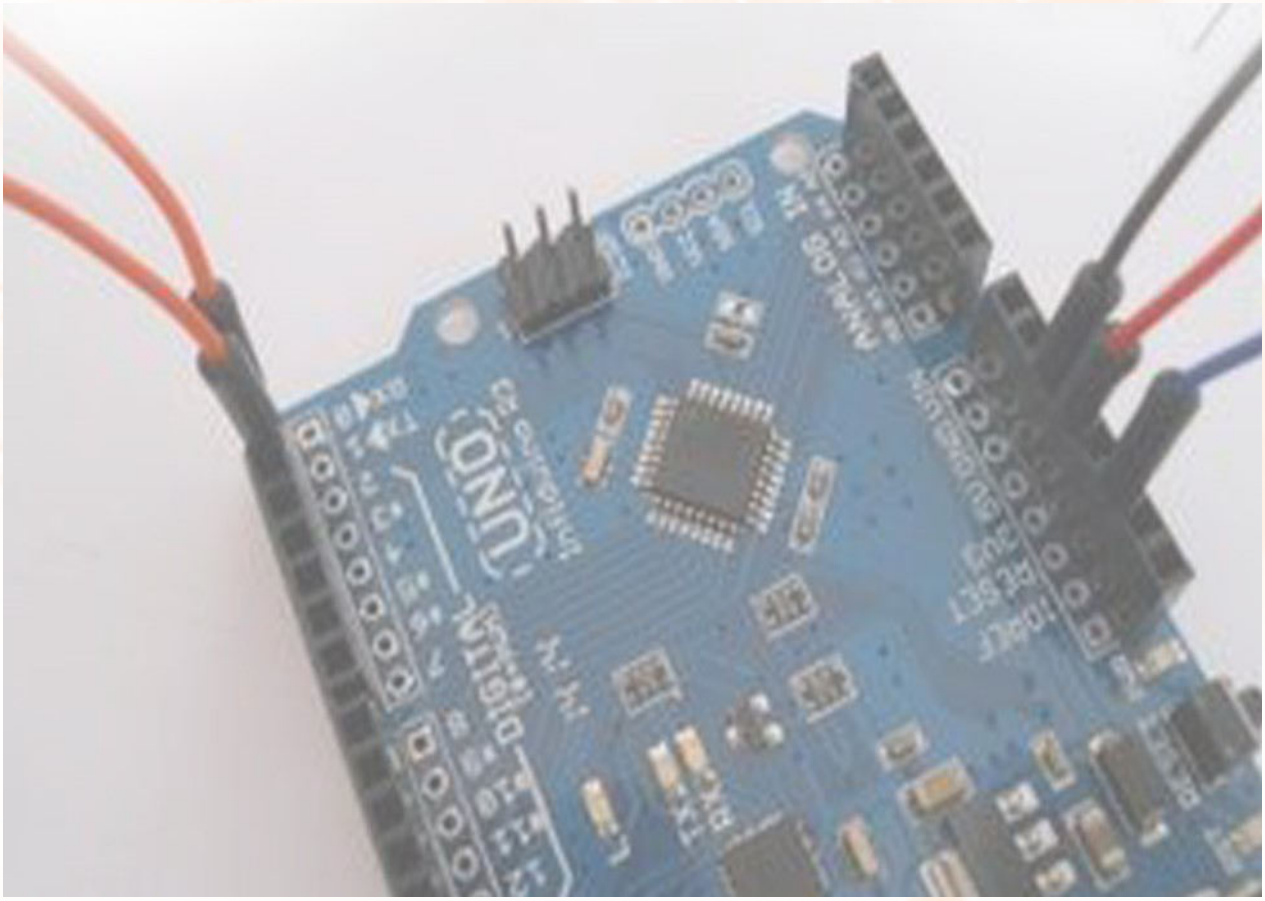


Figure 7 Robot Sumo hardware configuration (example)

PROJECT BRIEF

DEC50122 EMBEDDED ROBOTIC



SEMESTER 4

DEE40082 –PROJECT 1

DEC50122 –EMBEDDED ROBOTIC

PROJECT BRIEF – COURSE OUTLINE

KEMENTERIAN PENGAJIAN TINGGI

POLITEKNIK MALAYSIA
PORT DICKSON

COURSE OUTLINE SESSION DISEMBER 2020

DEC50122 EMBEDDED ROBOTIC

Credit(s) : **2**
Duration : **Lecture – 14 hours, Practical – 28 hours**
Prerequisite(s) : **DEC20012**

1.0 SYNOPSIS:

EMBEDDED ROBOTIC presents the combination of mobile robots and embedded systems, from introductory to intermediate level. It is structured in three parts, which are embedded systems, mobile robot, and mobile robot applications. These parts are essential to students in mastering the crucial steps of building a complete working robotic system. They will help them to develop robots that not only can move, but intelligent as well

2.0 PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

The engineering programme should produce balanced TVET graduates who are:
PEO1: practicing technician in electrical engineering related field
PEO2: contributing to society with professional ethic and responsibilities
PEO3: engaging in enterprising activities that apply engineering knowledge and technical skills PEO4: engaging in activities to enhance knowledge for successful career advancement

3.0 LEARNING OUTCOMES

Upon completion of this course, students should be able to: -

Course Learning Outcome (CLO)		PO ETAC	Clusters (CLS)
CLO1	investigate the concept and fundamentals of mobile robotic, embedded controller, sensors and actuators based on land mobile robot design (C4, PLO4)	PLO4 **(Investigation)**	CLS2 **Cognitive Skills**
CLO2	design the concept of robot positioning, identification and communication in mobile robot control according to a standard robot organization regulation (C6, PLO3)	PLO3 **(Design/Development of Solutions)**	CLS2 **Cognitive Skills**
CLO3	manipulate the application of sensor and actuator, robot identification and communication during practical work based on land mobile robot design (P4, PLO5)	PLO5 **(Modern Tools Usage)**	CLS3a **Practical Skills** CLS3c **Digital & Numeracy Skills**
CLO4	demonstrate good ability in managing a well-defined engineering-based project in a cost effective manner (A3, PLO11)	PLO11 **Project Management and Finance**	CLS4 **Personal & Entrepreneurial Skills**

4.0 TEACHING METHODOLOGY
Interactive Lecture, Discussion and Practical Work

5.0 WEEKLY SCHEDULE

WEEK OF LECTURE	DATE	COURSE CONTENT OUTLINE &
Week 1 (1 Hours)	8/3/2021- 14/3/2021	**1.0 INTRODUCTION TO ROBOTIC CONTROLLER** • Concept and fundamentals of robots and controller - Mobile robots - Classification of mobile robot types: i. Land ii. Aerial iii. Underwater • Significance of embedded controllers in mobile robotics.
Week 2 (1 Hours)	15/3/2021- 21/3/2021	**2.0 SENSORS AND ACTUATORS** • Sensor categories - Sensor categories according to their output signals - analog versus digital sensor - Sensor categories according to their applications - Difference between passive and active types of sensors
Week 3 (1 Hours)	22/3/2021- 28/3/2021	• Sensor and actuator theory of operation - Sensor theory of operation for the following: i. Analog sensor - potentiometer or light or temperature sensor ii. Digital sensor - tactile or distance or motion sensor iii. Orientation or velocity sensor - compass or gyroscope or accelerometer or IMU sensor - Actuator theory of operation for the following: i. DC motor ii. Stepper motor iii. Servo motor
Week 4 (1 Hours)	29/3/2021- 4/4/2021	• Sensor and actuator in robotic application - Assign the following type of sensors used in robotic application i. Light sensor - LDR or photodiode or photo-resistor ii. Distance sensor - rotary encoder or infrared or ultrasonic sensor
Week 5 (1 Hours)	5/4/2021- 11/4/2021	• Types of methods to control motor speed or direction in mobile robots using the following: i. Motor speed control - Pulse Width Modulation (PWM) ii. Motor direction control -H-Bridge **QUIZ 1 (T1-T2)**
Week 6 (1 Hours)	12/4/2021- 18/4/2021	**3.0 MOBILE ROBOT DESIGN** • Mobile robot control - Balancing robot i. Balancing robot based on inverted pendulum ii. Sensor used to balance the robot **QUIZ 2 (T1-T2)**
Week 7 (1 Hours)	19/4/2021- 25/4/2021	• Walking robot i. The importance of walking robot ii. Multi-legged walking robot design iii. Bipedal walking robot design
Week 8 (1 Hours)	26/4/2021- 2/5/2021	• Concept of mobile robot driving design - Mobile robot driving methods using the following: i. Single wheel drive ii. Differential drive iii. Ackerman steering iv. Omni-directional drive

Week 9 (1 Hours)	3/5/2021- 9/5/2021	• Mobile robot driving method - Manipulate algorithm for mobile robot control for the following: i. Differential drive ii. Omni-directional drive
Week 10 (1 Hours)	17/5/2021- 23/5/2021	**4.0 MOBILE ROBOT APPLICATION** • Robot soccer - Robot soccer competition - Robot soccer team structure - Sensors and actuators in robot soccer system - Strategy algorithm for player robot
Week 11 (1 Hours)	24/5/2021- 30/5/2021	• Localization and navigation - Importance of localization and navigation task in mobile robots - Localization system for indoor and outdoor using the following: i. Indoor - Wi-Fi, sonar, dead reckoning or radio beacon ii. Outdoor - GPS or camera •
Week 12 (1 Hours)	31/5/2021- 6/6/2021	• Real time image processing - Significance of image processing in mobile robotic - Camera interface - Colour space using two of the following: i. RGB ii. HSI or HSL or HSV iii. YUV - Colour object detection by computer software
Week 13 (1 Hours)	7/6/2021- 13/6/2021	• Robot wireless communication - The most commonly used communication technology in controlling mobile robot: i. Infrared ii. Radio frequency iii. Bluetooth iv. WLAN • Robot wireless communication - A system using wireless device(s) to control mobile robot.
Week 14 (1 Hours)	14/6/2021- 20/6/2021	**THEORY TEST (T1-T4)**
Week 15	21/6/2021- 27/6/2021	REVISION WEEK
	28/6/2021- 4/7/2021	**FINAL EXAMINATION**

6.0 ASSESSMENT:

Continuous Assessment (CA) – 100%

No.	Assessment	TOPIC	Number (minimum)	Week	% total
1	Quiz –CLO1	T1-T2	2	W5, W6	10
2	Theory Test – CLO1, CLO2	T1-T4	1	W14	20
3	Practical Work – CLO3, P4 PW1 – PW3 PW4 – PW6	T1-T4	6	Refer to Practical Work Schedule	50
4	Mini Project – CLO1, CLO2, CLO3, CLO4	T1-T4	1	W14	20
TOTAL CONTINUOUS ASSESMENT (CA)					**100**

Practical Work Title	Hours	Week	Date
PRACTICAL 1: INTRODUCTION TO ARDUINO MICROCONTROLLER (CLO3)	**4**	Week 1	8/3/2021-14/3/2021
		Week 2	15/3/2021-21/3/2021
PRACTICAL 2: SENSOR (CLO3)	4	Week 3	22/3/2021-28/3/2021
		Week 4	29/3/2021-4/4/2021
PRACTICAL 3: ACTUATORS (CLO3)	4	Week 5	5/4/2021-11/4/2021
		Week 6	12/4/2021-18/4/2021
PRACTICAL 4: MOBILE ROBOT CONTROL (CLO3)	4	Week 7	19/4/2021-25/4/2021
		Week 8	26/4/2021-2/5/2021
PRACTICAL 5: MOBILE ROBOT CONTROL BY USING REMOTE CONTROL (CLO3)	4	Week 9	3/5/2021-9/5/2021
		Week 10	17/5/2021-23/5/2021
PRACTICAL 6: MOBILE ROBOT ADVANCE CONTROL (LINE FOLLOWER) (CLO3)	4	Week 11	24/5/2021-30/5/2021
		Week 12	31/5/2021-6/6/2021
MINI PROJECT (CLO3)	4	Week 13	7/6/2021-13/6/2021
		Week 14	14/6/2021-20/6/2021
Overall Total SLT	**28**		

8.0 STUDENT LEARNING TIME (SLT)

Lecture	12
Practical	26
Independent Learning (NF2F)	25
Course Assessment	4
Course Assessment (NF2F)	13
SLT	**80**
Credit =SLT/40	**2**

9.0 REFERENCES

Main reference supporting the course

Bräunl, T. (2013). Embedded Robotics: Mobile Robot Design and Applications.3rd ed. Germany. Springer-Verlag Berlin and Heidelberg GmbH & Co.

Additional references supporting the course

Bradski, G. & Kaehler, A. (2016). Learning OpenCV 3: Computer Vision in C++ with the OpenCV Library. United States. O' Reilly Media, Inc, USA

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Jaulin, L. (2015). Mobile robotics. Amsterdam: Elsevier.

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Tzafestas S. G. (2018) Introduction to Mobile Robot Control. United States.Elsevier

Yellavula, N., Garrido Calvo,G. & Joshi,P.(2018). OpenCV 3.x with Python By Example. 2nd ed. United Kingdom.Packt Publishing Limited

Prepared by,

(SITI ZALINA BINTI MOKHTAR)
Course Coordinator
Date: 7/3/2021

Verified by:

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Ketua Program
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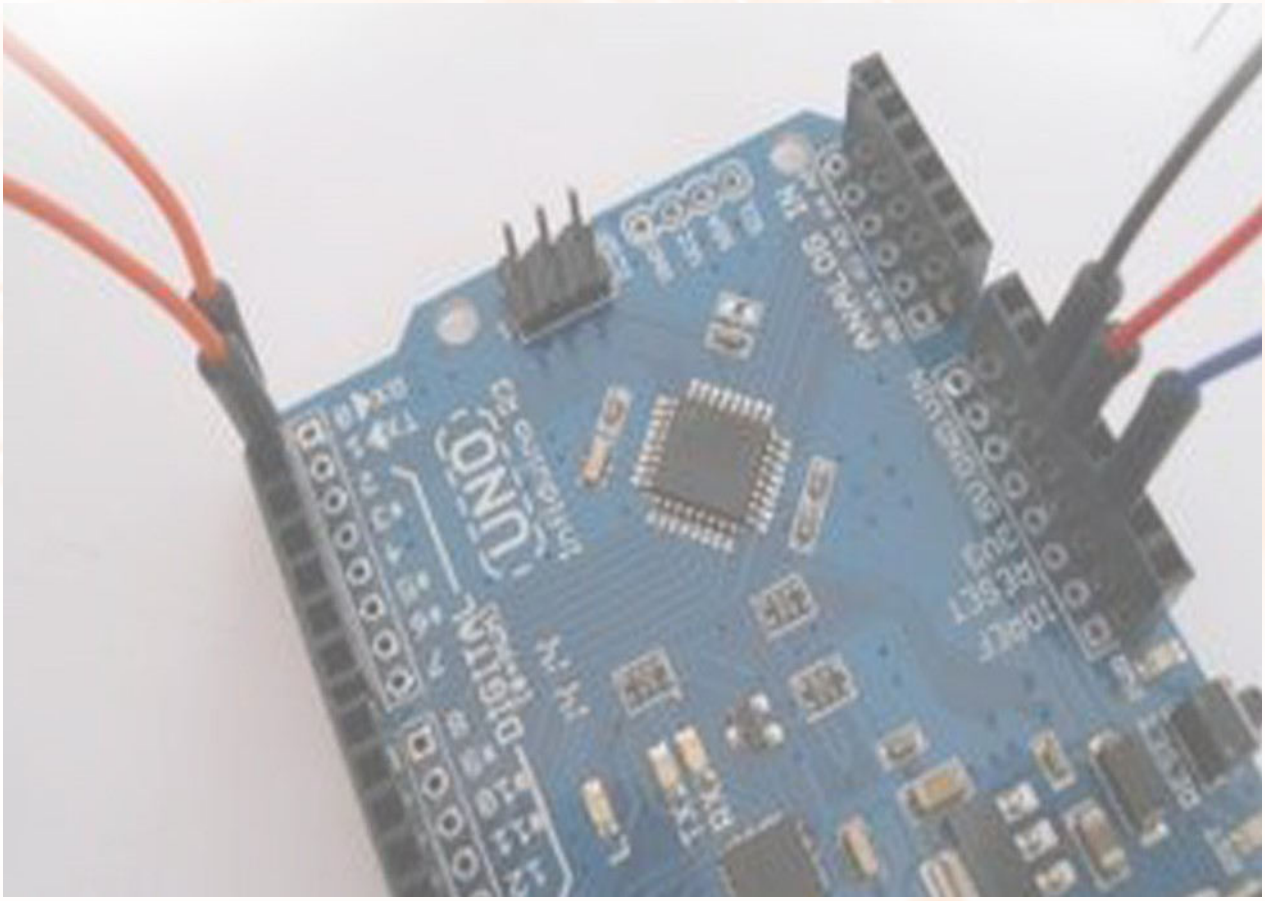
Jabatan Kejuruteraan Elektrik
Politeknik Port Dickson

( )
Head of Programme
Date : 7/3/2021

RUBRICS

DEC50122 EMBEDDED ROBOTIC



SEMESTER 4

DEE40082 –PROJECT 1

DEC50122 –EMBEDDED ROBOTIC

DEC50122 PRACTICAL SKILL RUBRIC

NO.	SCORE ASPECT	0 NOT ACHIEVED	1 MODERATELY	2 MODERATELY	3 HIGHLY COMPETENT	4 OUTSTANDING
1.	Able to upload programming code from Arduino IDE to Arduino Uno.	Cannot able to upload programming code from Arduino IDE to Arduino Uno	Able to upload programming code from Arduino IDE to Arduino Uno with MORE errors	Able to upload programming code from Arduino IDE to Arduino Uno with SOME errors	Able to upload programming code from Arduino IDE to Arduino Uno with LESS errors	Able to upload programming code from Arduino IDE to Arduino Uno.
2.	Able to configure or connect components (Sensor and Actuator) to the Microcontroller according to programming code.	Can't configure or connect components (Sensor and Actuator) to the Microcontroller according to programming code.	Able to configure or connect components EITHER Sensor OR Actuator to the Microcontroller according to programming code.	Able to configure or connect components BOTH Sensor and Actuator to the Microcontroller according to programming code with SOME error	Able to configure or connect components (Sensor and Actuator) to the Microcontroller according to programming code with A FEW error	Able to configure or connect components (Sensor and Actuator) to the Microcontroller according to programming code.
3.	Able to test the sensor functionality: i. Ultrasonic/infrared functionality ii. Line follower.	Can't test the sensor functionality ALL i. Ultrasonic/infrared functionality ii. Line follower.	Able to test the sensor functionality EITHER i. Ultrasonic/infrared functionality OR ii. Line follower.	Able to test the sensor functionality BOTH with some error i. Ultrasonic/infrared functionality ii. Line follower.	Able to test the sensor functionality with A FEW error i. Ultrasonic/infrared functionality ii. Line follower.	Able to test the sensor functionality: i. Ultrasonic/infrared functionality ii. Line follower.
4.	Able to test the actuator functionality: i. Ackerman Drive ii. Differentiate Drive	Can't test the actuator functionality ALL i. Ackerman Drive ii. Differentiate Drive	Able to test the actuator functionality EITHER: i. Ackerman Drive OR ii. Differentiate Drive	Able to test the actuator functionality BOTH with some error i. Ackerman Drive ii. Differentiate Drive	Able to test the actuator functionality with A FEW error i. Ackerman Drive ii. Differentiate Drive	Able to test the actuator functionality: i. Ackerman Drive ii. Differentiate Drive
5.	Robot function according to strategy	Robot CANNOT function according to strategy	Robot function EITHER sensor OR actuator part only according to strategy	Robot function with SOME error according to strategy	Robot function with A FEW error according to strategy	Robot function according to strategy

REFERENCES

1. DEE40082 Project 1 Syllabus, Dokumen Kurikulum Jabatan Kejuruteraan Elektrik, Bahagian Kurikulum Jabatan Pendidikan Politeknik dan Kolej Komuniti, Kementerian Pengajian Tinggi.
2. DEC50122 Embedded Robotic Syllabus, Dokumen Kurikulum Jabatan Kejuruteraan Elektrik, Bahagian Kurikulum Jabatan Pendidikan Politeknik dan Kolej Komuniti, Kementerian Pengajian Tinggi.
3. DEE40082 Project 1, Notes of Guidance, Jabatan Kejuruteraan Elektrik, Politeknik Port Dickson.
4. Buku Panduan Pelaksanaan Projek Pelajar (Program Diploma), Politeknik Malaysia Edisi 2021, Bahagian Instruksional dan Pembelajaran Digital, Jabatan Pendidikan Politeknik dan Kolej Komuniti, Kementerian Pengajian Tinggi