



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 5 Examination in Engineering: October/November 2019

Module Number: ME5311 Module Name: Mechatronics and Embedded Systems

[Three Hours]

[Answer all questions, each question carries ten marks]

- Q1 a) Define Electro - Mechanical Integration Process. [2.0 Mark]
- b) State the three advantages of Embedded Controller based Sensor System related to Mechatronics Systems implementation by giving necessary examples. [3.0 Mark]
- c) The Automatic door opening systems are used in commercial buildings, shopping malls, theatres, etc. These systems are used to open the door when a person comes near to the entrance of the door and closes it after he moves away from the door (at entry or exit). There are various kinds of sensors available in the market to make such systems. A leading consumer manufacturer has decided to design a "Smart door way system for domestic use" and introduce it to the local market.
- i) Identify and explain the key features required for the proposed door way system.
- ii) State two possible sensors can be used for detecting the presence of a person in front of the door.
- iii) Demonstrate the possible the design of the proposed system using a block diagram.
- iv) State the hardware components you suppose to use to implement this system. [5.0 Mark]
- Q2. a) Briefly explain the following terms.
- i) Analog to Digital Conversion
- ii) Active and Passive Sensing
- iii) MCU [4.0 Mark]
- b) i) A fire alarm is a unit made of several devices, which uses visual and audio signaling to warn people about a possible fire, smoke, or carbon monoxide occurrence in the area of coverage. Automatic fire alarm systems are activated through fire detectors, such as smoke or heat sensors. Smart Fire Alarm Systems are available in many different types in different applications. State and explain two the advantages and disadvantages of the selected Smart Fire Alarm Systems.

- ii) Demonstrate its implementation of a Smart Fire Alarm system by using a suitable flow chart.
- iii) If the application also require a temperature sensor to monitor the atmospheric temperature state the factors you would need to consider.

[6.0 Mark]

Q3 a) Explain the term "IDE".

[1.5 Mark]

b) Modern Embedded Systems use many different time keeping mechanisms to overcome problems caused by malfunctions. The "Pre-Scaler" is one such mechanism. Explain the functionality of a Pre-Scaler in typical embedded applications.

[1.5 Mark]

- c) i) Explain the term "interrupt" using necessary examples.
- ii) Compare the architectures of RISC and CISC.

[3.0 Mark]

d) Windshield control is a vital operation for a driver during driving. The mountings fitted in the windscreen (windshields) are essential for smooth driving. These can be automated by using sensors and an embedded microcontroller. A complete windshield controlling system can be developed to increase human comfort and flexibility. The wiper is controlled by a water level sensor which regulate the wiper motor through sensing the level of water or rain. A dust sensor can be integrated to spill water on the windscreen and then wipe it. It senses when a certain level of dust get accumulated on the windscreen. A sun visor can be mounted inside the car to shade the driver's eye from sun would be easier to control by a servo motor. It requires an automatic sun visor be designed to be controlled through a light sensor which is used to measure the light intensity and send the signal to the main control unit.

- i) Design a process for the above application and explain it using a flow chart.
- ii) Figure Q3 depicts components of a typical windshield wiper system. State two additional changes you would make for the above application and briefly justify your decision.

[4.0 Mark]

- Q4 a) i) Explain the terms "SFR" and "UDR".
 ii) Explain the terms "H- Bridge Motor Controlling".

[4.0 Mark]

- b) The following program is written to drive a dc motor at a varying speed. After compiling it gives a few errors.

```
void main() {
PORTC = 00;
TRISC = 0;
Pwm_Init(5000);
Pwm_Start();

while (1) {
for(i=0;i<=255;i++)

{ Pwm1_Change_Duty(i);

delay(10); }
}}
```

- i) Identify the possible errors in the program and correct them.
 ii) The above program supposed to control an air flow rate in a drier using a dc fan. It requires to read the temperature using a temperature sensor to vary the air flow rate. Identify the components to implement the above application.
 iii) Develop a program to satisfy following requirements for the application in part ii).

Temperature	Fan speed (Percentage of top speed)
0-30° C	0%
31-60° C	30%
61-80° C	65%
81-100° C	100%

[6.0 Mark]

- Q5 a) i) Explain the factors to be considered when selecting “Sensors” for applications.
- ii) Identify the sensor shown in the Figure Q5 (a).
- iii) Figure Q5 (b) demonstrates a model of a sensor used to measure motion. Identify it and explain the working principle by giving a necessary example.

[4.0 Mark]

- b) An automated (car) parking system (APS) is a mechanical system designed to minimize the area and/or volume required for parking cars. Like a multi-story parking garage, an APS provides parking for cars on multiple levels stacked vertically to maximize the number of parking spaces while minimizing land usage. The APS, however, utilizes a mechanical system to transport cars to and from parking spaces (rather than the driver) in order to eliminate much of the space wasted in a multi-story parking garage. While a multi-story parking garage is similar to multiple parking slots stacked vertically, an APS is more similar to an automated storage and retrieval system for cars. A leading shopping mall located in a highly populated city calls proposal to install a dedicated APS. The dedicated APS needs to be online accessed by the customers who need to obtain their parking ticket also online. Once the car arrives the ticket has to be verified and directed to the dedicated parking slot grids starting from AA and ending KK. The first letter represents the Row number and the second letter represents the Column number respectively. As an example third row fourth column represents CD. Each cell or grid may contain the sensors to recognize the existence of a car. The initial design has to be produced by a flow chart and secondly a block diagram. The figure Q5 (c) demonstrates a typical APS.

- i) State the advantages and disadvantages of using APS for the above application.
- ii) State the suitable hardware components for the above application and state their relevance.
- iii) Draw a flow chart and explain its operation procedure.
- iv) Draw a simple sensor integration circuit to recognize the existence of a vehicle in the parking slot grid. And write a suitable program to interface the sensor.

[6.0 Mark]

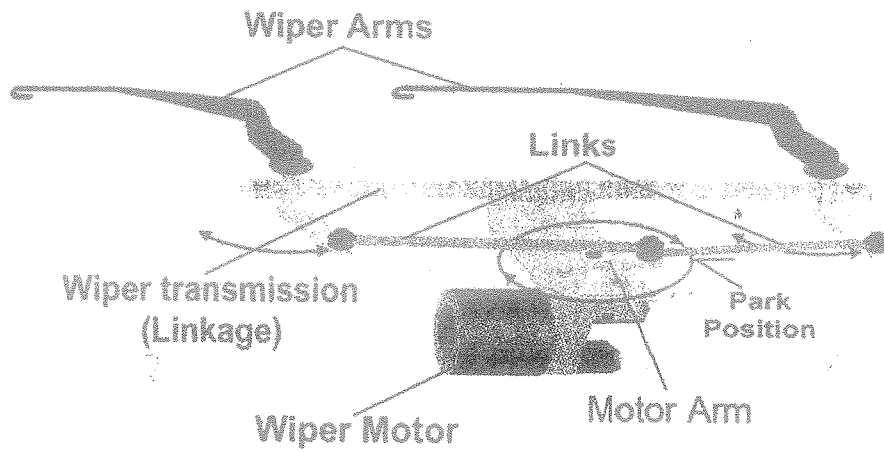


Figure Q3

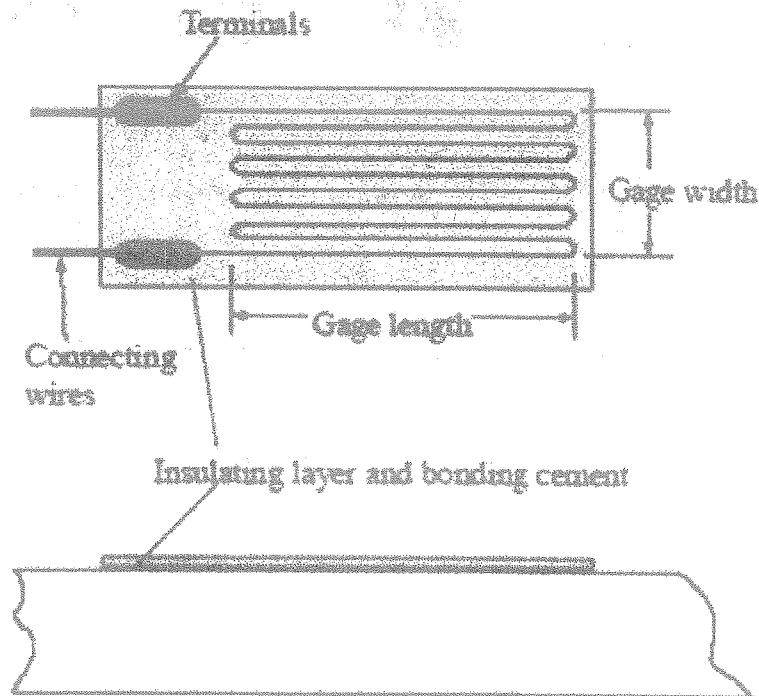


Figure Q5 (a)

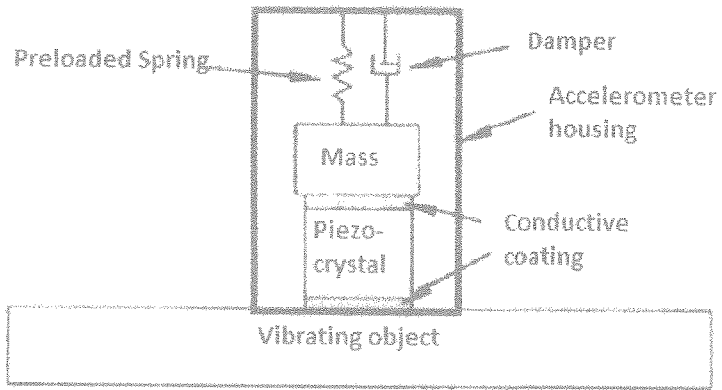


Figure Q5 (b)

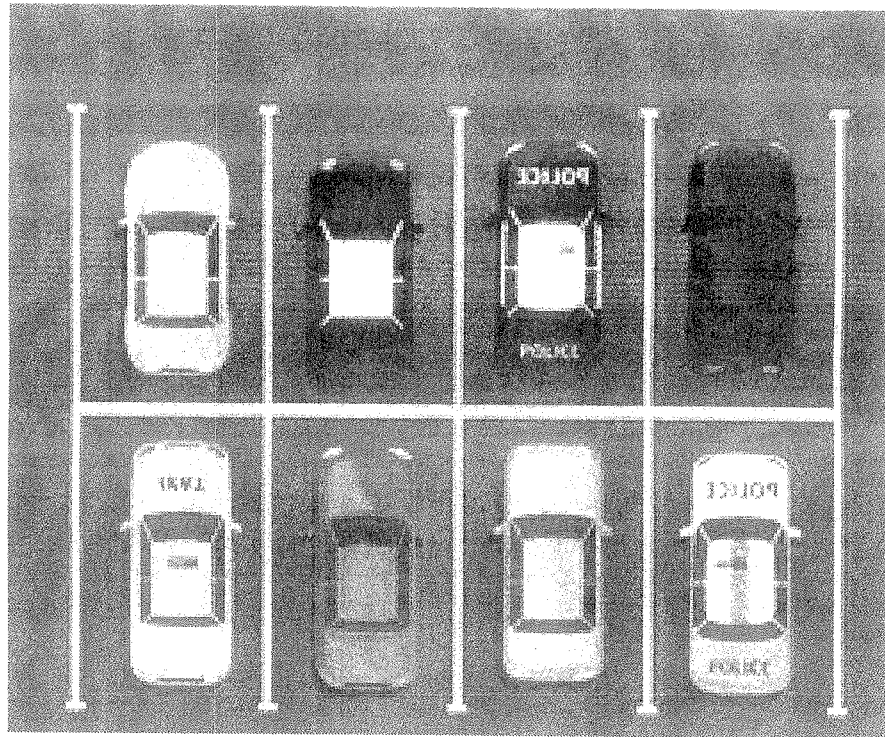


Figure Q5 (c) Car parking grids