UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2012/2013

COURSE NAME	:	MICROCONTROLLER APPLICATION
COURSE CODE	:	BER 4223/ BEX 44103
PROGRAMME	:	BEE
EXAMINATION DATE	:	JANUARY 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

Q1 A differential wheel mobile robot is controlled by Arduino Mega 2560 as given in Figure 1. This robot is driven by two 12VDC motors on left and right side. An LCD screen is attached on the robot for information display purposes.

(a) Design the interface circuit for controlling both motors by Arduino controller through the motor driver.

(5 marks)

(b) The speed of motor can be varied by using a few methods. Purpose the suitable method and construct the code statement to configure this method.

(5 marks)

(c) Write a subroutine to handle the motor speed and change direction for both motors.

(10 marks)

Q2 The movement of robot in question Q1 depends on an encoder sensor as shown in Figure 2.This encoder sensor is used to find the distance travelled by the robot. The encoder is attached to a wheel with 3cm of diameter.

(a) Design the interface circuit between the encoder circuit and Arduino controller.

(5 marks)

(b) Write a related configuration code for encoder sensor in ***void setup(void)*** subroutine

(5 marks)

(c) Write a code that is design to control robot movement. The robot will travel for 24cm distance and then stop. Develop a code that display the distance reading on the LCD screen.

(10 marks)

Q3 The robot in question Q1 position in degrees depends on a digital compass sensor as shown in Figure 3.

(a) Design an interface circuit between the digital compass and Arduino controller.

(5 marks)

(b) Write a related configuration code for digital compass sensor in ***void setup(void)*** subroutine.

(5 marks)

(c) Write a code that is design to control robot movement. The robot will rotate to a given value: 90^0,180^0,270^0 and 0^0. Develop a code that displays the robot rotational value on the LCD screen.

(10 marks)

Q4 A SXBEE Bluetooth module is the easiest wireless connection that used for communicating with android phone. This module shown on Figure 4 uses common serial interface with a baudrate setting (9600bps). This module does not need initialization code where it works as normal as wired serial interface. A program in android phone has four buttons that is used to control the robot in question Q1 for forward, backward, left, and right direction.

(a) Design the interface circuit between this module and Arduino controller. The speed of motor can be varied by using a few methods. Choose the suitable method.

(5 marks)

(b) Write a subroutine to manually handle and control the robot according the input command from android phone through DF Bluetooth module:

- If command received "moveF" then robot moves forward.
- If command received "moveB" then robot moves backward.
- If command received "moveL" then robot turns left.
- If command received "moveR" then robot turns right.

(15 marks)

Q5 An analog temperature sensor needs to be connected to Arduino controller and the temperature reading will be used to stop the movement of the robot in Q1.

(a) Design the interface circuit between this sensor and Arduino controller

(5 marks)

(b) Write a related subroutine to read temperature and save in one variable. Display the temperature reading on LCD screen.

(5 marks)

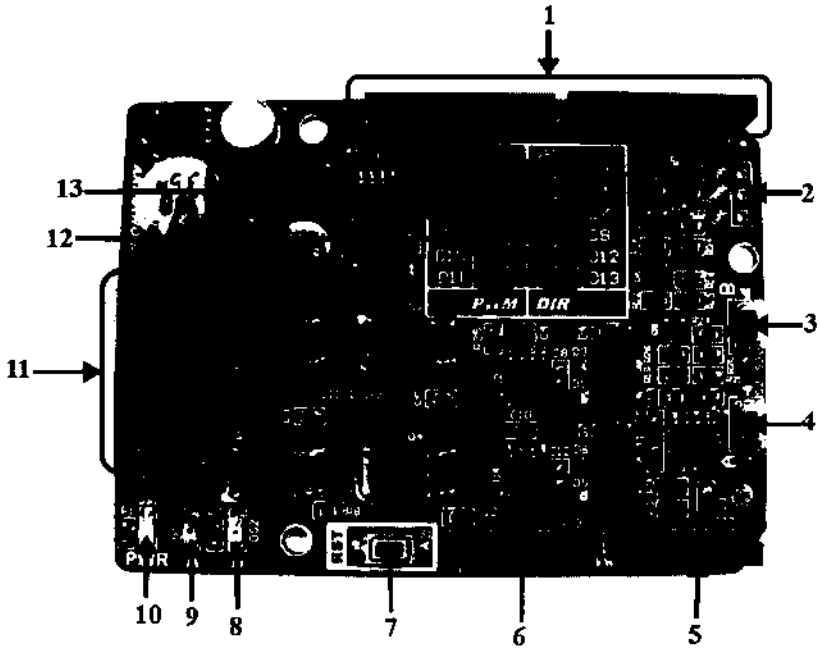
(c) Write a code to control robot movement that will to stop the robot movement if the temperature reading is more than 48 degrees Celsius. Develop a code that displays the robot temperature reading on the LCD screen.

(10 marks)

-END OF QUESTION-

FINAL EXAMINATION

SEMESTER/SESSION: SEM I/20122013 PROGRAMME:BEE
COURSE: MICROCONTROLLER APPLICATION COURSE CODE: BEX44103/BER4223



FIGURES 1: MD10 MOTOR DRIVER

MD10 Pin Description:

1. **Stackable Digital I/O Headers**
   JP4 and JP6 are Digital I/O pins stacked to the Arduino main board.

2. **Optional External Control**
   External control is for the use of other types of microcontroller besides Arduino.

3. **Test Button B**
   When this button is pressed, current flows from output B to A and motor will turn CCW (or CW depending on the connection).

4. **Test Button A**
   When this button is pressed, current flows from output A to B and motor will turn CW (or CCW depending on the connection).

5. **Stackable Analog Input Header**
   This is the analog port of the Arduino and is not used by SHIELD-MD10. The stackable header allows other stacked shield to utilize these pins.

FINAL EXAMINATION

SEMESTER/SESSION: SEM I/20122013 PROGRAMME:BEE
COURSE: MICROCONTROLLER APPLICATION COURSE CODE: BEX44103/BER4223

6. **Stackable Power Pins Header**
   This is the power port of the Arduino. Only RST and GND pins are connected to the SHIELD-MD10. The stackable header allows other stacked shield to utilize these pins.
7. **Reset Button**
   Reset button is for the convenience of user to reset the Arduino main board.

8. **Red LED B**
   Turns ON when the output A is low and output B is high. Indicates the current flows from output B to A.

9. **Red LED A.**
   Turns ON when the output B is low and output A is high. Indicates the current flows from output A to B.

10. **Green Power LED**
    Turn on when the SHIELD-MD10 is powered up.

11. **Terminal Block**
    Connect to motor and power source.

Pin No.	Pin Name	Description
1	POWER +	Positive supply
2	GND -	Negative Supply
3	Motor Output A	Connect to motor terminal A
4	Motor Output B	Connect to motor terminal B

12. **PWM Pin Selector**
    User may select D3, D5, D6, D9, D10 or D11 as the PWM pin for SHIELD-MD10 with the mini jumper.

13. **DIR Pin Selector**
    User may select D2, D4, D7, D8, D12 or D13 as the direction pin for SHIELD-MD10 with the mini jumper.

FINAL EXAMINATION

SEMESTER/SESSION: SEM I/20122013
COURSE: MICROCONTROLLER APPLICATION

PROGRAMME:BEE
COURSE CODE: BEX44103/BER4223

FIGURES 2: ROTARY ENCODER B106

Rotary Encoder B106 details:

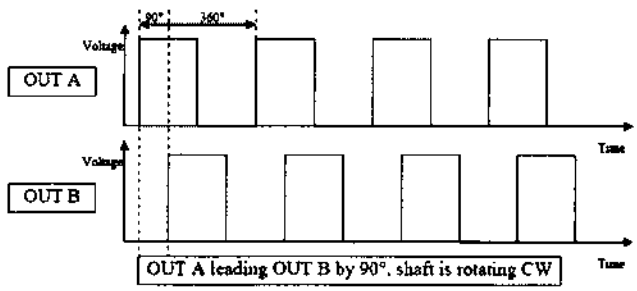
• Wide operating range, from 5V to 24V

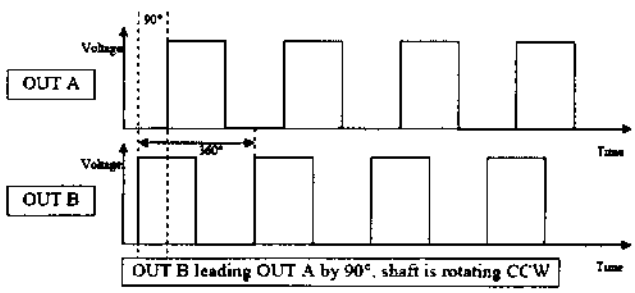
B106 pin configuration:

Cable Connection

Cable color	Red	Black	Blue	White	Yellow
Signal	DC +5V to +24V	Gnd	OUT A	OUT B	OUT Z
Function	Input Voltage	Ground	Digital Output	Digital Output	Digital Output

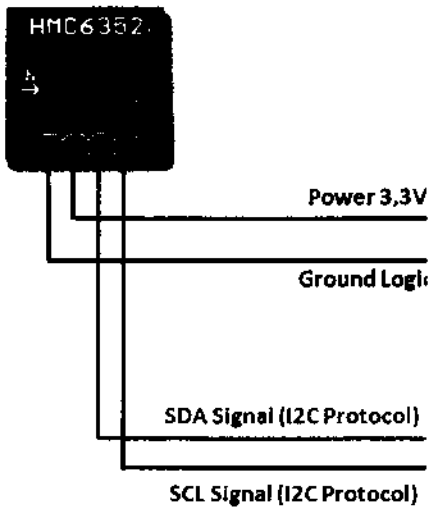
B106 configuration for direction:





FINAL EXAMINATION

SEMESTER/SESSION: SEM I/20122013 PROGRAMME:BEE
COURSE: MICROCONTROLLER APPLICATION COURSE CODE: BEX44103/BER4223



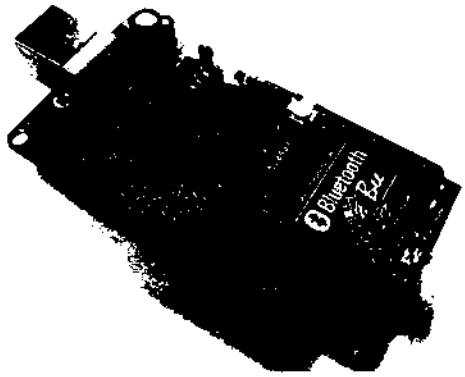
FIGURES 3: HMC6352 DIGITAL COMPASS WITH PIN CONFIGURATION

HMC6352 Features:

- Simple **I2C** interface
- 1 to 20Hz selectable update rate
- I2c Address (0x42)
- I2C Command to get Angle Position ('A')

FINAL EXAMINATION

SEMESTER/SESSION: SEM I/20122013 PROGRAMME:BEE
COURSE: MICROCONTROLLER APPLICATION COURSE CODE: BEX44103/BER4223

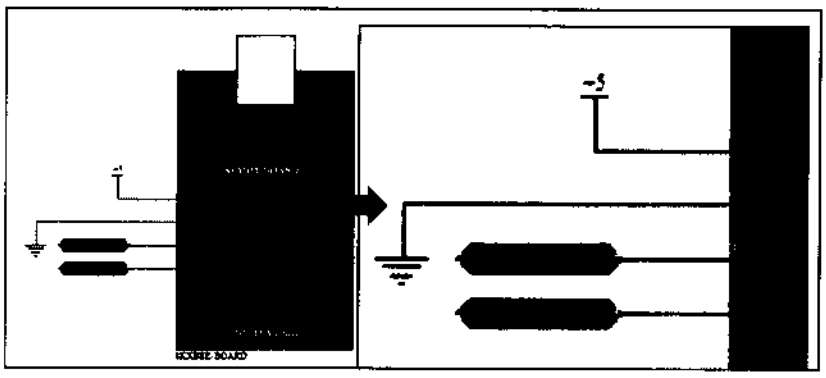


FIGURES 4: BLUETOOTH MODULE SKXBEE BOARD

Features:

-
- Operating frequency: 2.4 ~ 2.48GHz unlicensed ISM band
- Modulation: GFSK (Gaussian Frequency Shift Keying)
- Transmission distance: 20 ~ 30m in free space
- Safety features: Authentication and encryption
- Support profiles: Bluetooth serial port
- Serial port settings: 1200 ~ 1382400 / N / 8 / 1
- Baud rate default: 9600 (Serial Port Profile)
- Pair Number/ID: 1234
- Input Voltage: +3.3 DC/50Ma

Pin Configuration:



FINAL EXAMINATION

SEMESTER/SESSION: SEM I/20122013 PROGRAMME:BEE
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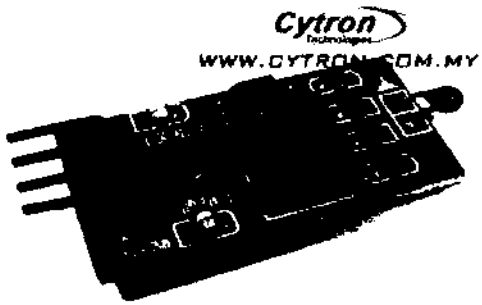

FIGURES 5: TEMPERATURE SENSOR

Feature Temperature sensor:

- Linear + 10.0 mV/°C scale factor
- Come with analog and digital output.
- On board power indicator LED and digital state indicator LED.

Pin Configuration:

- **VCC** = 3.3V to 5VDC
- **GND** = GND of power and signal
- **DO** = digital output, can be adjusted using on board potentiometer. Output LOW when temperature sensed low then threshold. Can be interface directly with microcontroller's digital input.
- **AO** = Analog output, output from resistor ladder which form a voltage divider. Can be interface directly to microcontroller's analog input.