UNIVERSITY OF MORATUWA
Faculty of Engineering
B.Sc. Engineering
Semester 3 Examination

EN 2532 – ROBOT DESIGN AND COMPETITION

Time Allowed: **1 hour**

November 2014

INSTRUCTIONS TO CANDIDATES

This paper contains 40% of the total grading of the subject

This paper contains 50 multiple-choice questions (MCQ) in 8 pages (page 2 to page 8)

Use the provided answer script to cast your answers

This is a **closed** book exam.

1. How can you identify different coils of a stepper motor?
   a. using an ohmmeter
   b. ask the manufacturer
   c. trial and error
   d. by a drive test

2. Which of the following components is used to protect the motor control IC form the back EMF of the motor?
   a. a zenner diode
   b. a voltage regulator IC
   c. a resistor
   d. a free wheeling diode

3. The register that is used to set the direction of PIC microcontroller pins is
   a. INTCON b. STATUS c. PIR d. TRIS

4. How many analogue pins are available in the PIC18f452 microcontroller?
   a. 5 b. 10 c. 8 d. 12

5. Which of the following statements is **not** true about soldering?
   a. strip 1/8"- 1/4" insulation at wire ends
   b. tin the ends evenly
   c. always use a standard heat gun for heat shrink
   d. use 1/4" heat shrink tubing

6. Pullup resisters are used in sensor interfacing to improve
   a. dynamic range
   b. response time
   c. linearity
   d. sensitivity

7. Which of the followings is not involved in A/D conversion of a PIC microcontroller?
   a. Channel
   b. Voltage reference source
   c. Duty cycle
   d. Clock source

8. In a four-phase unipolar step motor
   a. 8-step sequence doubles the resolution of motion
   b. 8-step sequence increases torque by 1.4 times
   c. energizing two coils at a time increases resolution of motion
   d. energizing two coils at a time doubles the torque

9. Which of the following statements is not true about Sense-Plan-Act strategy of robot control?
   a. it slows down robot motion
   b. it is not appropriate to achieve multiple objectives
   c. at each step, sensor fusion, world modeling, and planning take place
   d. is not applicable for complex, dynamic environments

a. a four-phase unipolar step motor
a. 8-step sequence doubles the resolution of motion
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11. Which of the following statements is not true about 28guage ribbon cable, which is widely used in small robots
a. it zips multiple wires
b. it is stranded and flexible
c. its multicolours are helpful
d. it has quite good current handling capacity

12. Suppose that your robot has two wheels with a diameter of 7cm. You have an encoder with 30 ticks per revolution fixed to the motor shaft. If you need to travel 33cm and stop, what should be the value of TIMER0 to stop the motors? (TIMER0 is 8-bits wide, prescaler 1:1 , two motors are identical)
a. 25 b. 45 c. 255 d. 333

13. Which of the following pins are used to load the program (Hex file) to the microcontroller when programming using the bootloader?
a. The Serial port or UART pins (Tx,Rx).
b. The program data and clock (PGD,PGC) pins.
c. The Serial peripheral interface (SPI) pins.
d. The I2C pins (SCL,SDA).

14. Passive IR sensors are commonly used to
a. measure IR intensity at some place
b. measure distances
c. measure humidity
d. measure temperature

15. If the external oscillator of a microcontroller (PIC18f452) has a value of 40MHz, then what is the time taken to execute one instruction cycle?
a. 25 ms b. 40 ms c. 100 us d. 200 us

16. Which of the following techniques is more appropriate for wheel speed measurement at low speeds?
a. Counting pulses using a break-beam sensor
b. Measuring time between break-beam pulses
c. Use a tachometer → display RPM
d. Use a proximity sensor

17. Stall current of a motor is
a. the maximum current it draws
b. the maximum current it can handle
c. measured when the motor runs at rated RPM
d. written on the motor cover plate

18. Winch servo
    a. is a servo motor without feedback signal
    b. is a modified servo system for speed control
    c. is a modified servo for more power
    d. uses the PWM control signal to command the speed

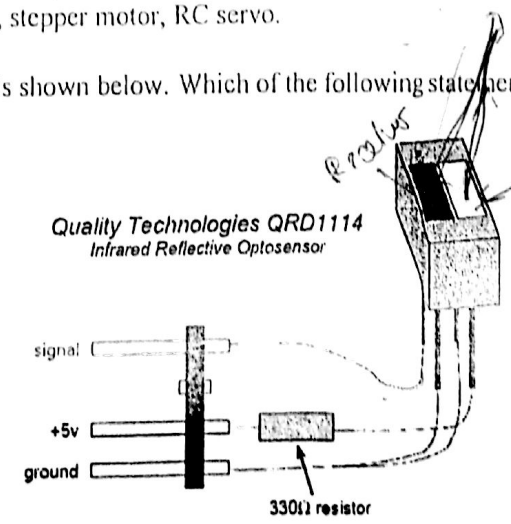
19. Proper implementation of pulse width modulation (PWM)
    a. needs a very high switching frequency
    b. is used for speed control of DC motors
    c. is used for servo position control
    d. can be used for step motor control

20. A switch sensor can be used for
    a. contact sensing
    b. collision detection
    c. limiting rotation
    d. all of the above tasks

21. Wheel speed measurement in low speed is to be done
    a. by counting pulses of a break-beam sensor
    b. by measuring time between break-beam pulses
    c. by using a tachometer
    d. by using a distance sensor

22. What types of motors are generally used in hobby robotics?
    a. brushed DC motor, AC motor, RC servo motor
    b. brushed DC motor, stepper motor, RC servo motor
    c. AC motor, stepper motor, RC servo
    d. brushless DC motor, stepper motor, RC servo.

23. A reflective optosensor is shown below. Which of the following statements is not true



    a. It does not operate properly as it is
    b. 330Ω resistor is used to makes a voltage divider circuit
    c. 330Ω is used to limits the current through the emitter
    d. the sensor gives an analog signal

24. Which of the following statements is not true about IR sensors
    a) they are susceptible to ambient light
    b) they always need signal conditioning for proper operation
    c) they can be used as analog or a digital sensor
    d) they need to be calibrated

25. A switch sensor can be used for
    a. contact sensing
    b. collision detection
    c. limiting rotation
    d. all of the above tasks

26. Which of the following is a motor driving IC?
    a. 16F877A
    b. dSPIC
    c. ATmega328
    d. L298

27. Maximum resolution of the A/D converter of PIC18F452 is
    a. 128 bit b. 256 bits c. 512 bits d. 1024 bits

28. Which of the following statements is true about active IR range sensor?
    a. It has only one IR detector
    b. It has only one IR emitter
    c. It has one IR emitter and one IR detector
    d. It has one IR filter

29. Which of the following methods is used in the development board to protect motor control IC against back EMF of the motor?
    a. Using resistors
    b. Using free- wheeling diodes
    c. Using voltage regulators
    d. Using Zenner diodes

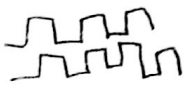
30. The most appropriate small robot controller is
    a. P controller
    b. PD controller
    c. PI controller
    d. PID controller

31. Passive IR sensors are commonly used to
    a. measure IR intensity at some place
    b. measure distances
    c. measure humidity
    d. measure temperature

32. The recommended maximum voltage for analogue input in PIC18f452 is
    a. 3.3 V b. 5 V c. 6 V d. 12 V

33. Which of the followings is not possible for a PIC18f452 microcontroller?
   a. drive stepper motor
   b. drive servo motor with encoder feedback
   c. output an analogue signal
   d. read analogue inputs

34. Quadrature shaft encoding
   a. has two break-beam sensors
   b. has a lookup table
   c. senses direction of motion of the wheel
   d. all of the above statements are true



35. The output voltage of an unregulated 12V power pack used in robot control boards is measured when is not connected to the robot. The reading will roughly be
   a) 12V b) 10V c) 16V d) cannot say

36. Your motor control board allows 1A, if you want to drive 2A motor what will you be doing
   a. piggyback another motor driving IC on the same board
   b. change the board to 2A rated one
   c. use the same board with short duty ratios
   d. none of the above

37. Which of the following is not considered when using a digital compass for a toy robot?
   a. Digital compass must be horizontally installed.
   b. Digital compass must be installed away from the metal parts.
   c. Digital compass gives better readings when installed closer to the earth surface.
   d. Digital compass needed to be calibrated before using it.

38. Which of the followings is not involved in A/D conversion of a PIC microcontroller?
   a. Channel
   b. Voltage reference source
   c. Duty cycle
   d. Clock source

39. Which of the following devices can be used for bidirectional dc motor control?
   a. Triac b. H-bridge c. Relays d. Diodes

40. Which of the following scenarios can easily distract a mobile robot navigated using IR sensors?
   a. navigation in a maze with white walls
   b. tracking a white line on black background
   c. navigating in the dark environment
   d. navigation in bright daylight

41. Which of the following properties has the most significant contribution in determining the range of an ultrasound sensor?
   a. Frequency of the ultrasound signal
   b. Power of the ultrasound burst
   c. Power of the ultrasound burst
   d. Input voltage of the sensor

42. For a DC motor control using PWM, the acceptable frequency range for the PWM frequency is
    a. 20Hz – 200Hz
    b. 1kHz – 20kHz
    c. 2kHz – 1MHz
    d. 2MHz – 20MHz

43. Your DC power adapter is rated for 9V/500mA. You check the output voltage without a load connected and found that it reads 14V. What is your conclusion?
    a. regulator specification is wrong
    b. regulator specification is correct
    c. open circuit voltage is higher than the rated voltage
    d. it is wise not to use the regulator

44. How can you use a 9.6V battery to drive 6V servo motor?
    a. Do not worry about the little extra voltage
    b. Use a resister to drop the voltage
    c. It is not possible
    d. Use IN4001 diodes to drop the voltage

45. A microcontroller unit consists of
    a. a CPU only
    b. a CPU, memory, and I/O
    c. a memory only
    d. a memory and I/O only

46. DC motor torque is proportional to
    a. PWM frequency
    b. motor current
    c. motor speed
    d. motor voltage

47. Stall current of a motor
    a. is the maximum current it draws
    b. is the maximum current it can handle
    c. is measured when the motor runs at rated RPM
    d. is written on the motor cover

48. Motor driving IC should be able to
    a. deliver rated current of the motor intermittently
    b. deliver stall current of the motor at rated speed
    c. deliver rated current of the motor continuously
    d. deliver the stall current of the motor continuously

49. A microcontroller has a built-in 8bit ADC and it operates at 5V. What would be the analog voltage from the sensor when the ADC readout is 150?

a. 2.92V
b. 0.64V
c. 3.00V
d. 1.50V

$\frac{5}{256} \times 150$

50. Echo output of a SRF05 sonar gave rise to a pulse of 6ms width. What is the distance to the object? (Speed of sound is 340 ms^{-1})

a. 0.51m b. 0.17m c. 1.53m d. 1.0m

$340 = \frac{d}{t}$

$\frac{340 \times 6 \times 10^{-3}}{2}$

$=$

- End of Paper -