

**UNIVERSITY OF MORATUWA**

Faculty of Engineering

B.Sc. Engineering

Level 2 – Semester 1 Repeat Examination

**008****EN 2060 – ROBOT DESIGN AND COMPETITION**Time Allowed: **1 hour**

March 2011

**INSTRUCTIONS TO CANDIDATES**

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

This paper contains 50 multiple-choice questions (MCQ) in 6 pages (page 3 to page 8).

Use the provided answer script to cast your answers.

This is a **closed** book exam.



1. 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
2. Pullup resistors are used in sensor interfacing to improve
  - a. dynamic range
  - b. response time
  - c. linearity
  - d. sensitivity
3. 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
4. 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
5. 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 motor
  - d. Brushless DC motor, Stepper motor, RC servo.
6. 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
7. A PWM motor control circuit is shown in Fig. 1. Which of the following statements is not true about it?
  - a. motor draws roughly 2/3 of the rated power
  - b. Motor runs at roughly 2/3 of its rated speed
  - c. motor draws roughly 2/3 of the rated current
  - d. diode conducts when the transistor is OFF
8. 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
9. 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 - 20 MHz



10. Which of the following statements is not true about IR sensors?
- they are susceptible to ambient light
  - they always need signal conditioning for proper operation
  - they can be used as analog or a digital sensor
  - they need to be calibrated
11. The standard servo pulse period is
- 20us
  - 2ms
  - 1us
  - 20ms
12. Which of the followings is not possible with a PIC18f452 microcontroller?
- Drive a stepper motor
  - Drive a servo motor with encoder feedback
  - Read an analogue input
  - Output an analogue signal
13. Which of the following statements most accurately describe an H-bridge?
- it is used for direction control of DC motors
  - it has 4 switching signals
  - it has 3 logic control signals
  - it has 4 logic gates
14. 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?
- regulator specification is wrong
  - regulator specification is correct
  - open circuit voltage is higher than the rated voltage
  - it is wise not to use the regulator
15. The recommended maximum voltage for analogue input in PIC18f452 is
- 3.3 V
  - 5 V
  - 6 V
  - 12 V
16. What are the parameters that are to be considered for generating a PWM waveform using a microcontroller?
- duty cycle, frequency, resolution
  - duty cycle, amplitude, resolution
  - phase, duty cycle, resolution
  - resolution, frequency, phase
17. Speed of a DC motor is proportional to the
- PWM signal frequency
  - voltage
  - current
  - stator magnetic strength
18. Which of the following devices could be used for bidirectional DC motor control?
- Diodes
  - Triac
  - H bridge
  - Relays



19. Which of the following statements is not true about unipolar step motors?
  - a. unipolar stepper motors have 5 or 6 wires
  - b. direction of motion is changed by changing direction of current through coils
  - c. motor coils can be identified by measuring resistance between wires
  - d. motor speed is proportional to pulse frequency
20. Which of the followings is not applicable for asynchronous serial transmission?
  - a. baud rate
  - b. voltage level
  - c. modulation frequency
  - d. communication protocol
21. 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
22. The communication protocol used by the boot loader to communicate with the robot development board is
  - a. USB
  - b. RS232
  - c. RS422
  - d. RS485
23. How many analogue pins are available in PIC18f452 micro controller?
  - a. 5 pins
  - b. 8 pins
  - c. 10 pins
  - d. 12 pins
24. 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 multi-colors are helpful for the designer
  - d. it has a quite good current handling capacity
25. Ultrasound sensor consists of an ultrasound transmitter and a receiver. Ultrasound sensors turn off its receiver when transmitting the ultrasound burst to avoid receiver being saturated from the transmitting signal. A particular ultrasound sensor turns on its receiver, 100us after transmitting the ultrasound burst. Given the speed of sound as 340m/s, the minimum distance which can be measured by the sensor is
  - a. 6.8cm.
  - b. 3.4cm.
  - c. 1.7cm.
  - d. 7.2cm.
26. Your motor control board is 6V rated. Which of the following statements is not true about this board?
  - a. you can drive a 9V motor from the board at 66% duty
  - b. a 5V motor will run faster when driven by the board
  - c. you can drive a 9V motor from the board at slow speeds
  - d. you can continuously drive 4V motor from the board
27. Which of the following devices can be used for bidirectional dc motor control?
  - a. Triac
  - b. H-bridge
  - c. Relays
  - d. Diodes



28. Which of the following statements is true about IR distance sensors?
- It has one IR detector
  - It has one IR emitter
  - It has one IR emitter and one IR detector
  - It has one IR filter
29. Motor driver IC should be able to
- deliver rated current of the motor intermittently
  - deliver stall current of the motor at rated speed
  - deliver rated current of the motor continuously
  - deliver the stall current of the motor continuously
30. The block C in the Figure 2 is
- a position sensor
  - an error amplifier
  - a pulse width to voltage converter
  - a pulse generator
31. For which of the following applications passive IR sensors could commonly be used?
- To measure IR intensity
  - To measure distance
  - To measure humidity
  - To measure temperature
32. Which of the following components is used to protect the motor control IC from the back EMF of the motor?
- a Zenner diode
  - a voltage regulator IC
  - a resistor
  - a free-wheeling diode
33. Passive IR sensors are commonly used to
- measure IR intensity at some place
  - measure distances
  - measure humidity
  - measure temperature
34. Referring to the Figure 2, what will happen if there is an angular error in the servo motor?
- the motor shuts off
  - the motor will turn for 180 degrees
  - it will always try to minimize the difference between the inverting (negative) and non-inverting (positive) inputs by driving its output
  - it will stop PWM function
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
- 12V
  - 10V
  - 15V
  - 13V
36. The register that is used to set the direction of PIC microcontroller pins is
- INTCON
  - STATUS
  - PIR
  - TRIS



37. Proper implementation of pulse width modulation (PWM)
- needs a very high switching frequency
  - is used for speed control of DC motors
  - is used for servo position control
  - can be used for step motor control
38. A servo system does not generally contain
- a DC motor
  - a gear reducer
  - a shaft encoder
  - a speed sensor
39. Which of the following techniques is more appropriate for wheel speed measurement at low speeds?
- Counting pulses using a break-beam sensor
  - Measuring time between break-beam pulses
  - Use a tachometer
  - Use a proximity sensor
40. SRF05 ultrasound sensor outputs a voltage pulse when it detects the reflection off a nearby object. This output pulse is sensed using a microcontroller timer and the timer increments its value every  $2\mu\text{s}$ . The measured timer value for an object in the vicinity is 278. What is the distance between the sensor and the object?
- 18.9cm
  - 9.4cm
  - 37.8cm
  - 28.4cm
41. Your motor control board allows 1A. Which of the following techniques will you adopt if you need to drive 2A?
- piggyback another motor driving IC on the same board
  - change the board to 2A rated one
  - use the same board with short duty ratios
  - none of the above
42. The maximum PWM resolution can be achieved using PIC18F452
- 1024
  - 512
  - 256
  - 128
43. Maximum resolution of the A/D converter of PIC18F452 is
- 128 bits
  - 256 bits
  - 512 bits
  - 1024 bits
44. Referring to the Figure 2, which of the following statements is true about the error amplifier?
- it is an operational amplifier with positive feedback
  - It always tries to minimize the difference between the inverting (negative) and non-inverting (positive) inputs by driving its output in the appropriate direction
  - It is an electronic circuit which converts a pulse width signal to a voltage signal
  - It is a position sensor
45. How many analogue pins are available in the PIC18f452 microcontroller?
- 5
  - 10
  - 8
  - 12



46. How can you use a 9.6V battery to drive 6V servo motor?
- Do not worry about the little extra voltage
  - Use a resistor to drop the voltage
  - It is not possible
  - Use IN4001 diodes to drop the voltage
47. What does the C18 instruction "TRISCbits.TRISC7 = 1" stand for?
- Setting PORTC7 pin direction as input
  - Setting PORTC7 register value as 1
  - Setting PORTC7 pin direction as output
  - Setting TRISC7 register direction as input
48. If the TIMER0 of PIC 18f452 has been configured 10bit, PS = 2 (prescaler) with 40 MHz external oscillator, what will be the time taken for a one timer counter?
- 0.1 us
  - 0.4 us
  - 0.25 us
  - 0.8 us
49. The most common small robot controller is
- P controller
  - PD controller
  - PI controller
  - PID controller
50. Which of these statements is not true about servo motors?
- a servo motor has three wires
  - PWM is used for reference command
  - its shaft can be positioned anywhere within 360deg
  - it does not allow speed control

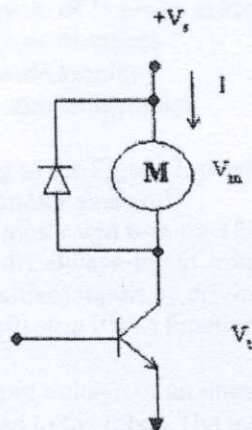


Figure 1

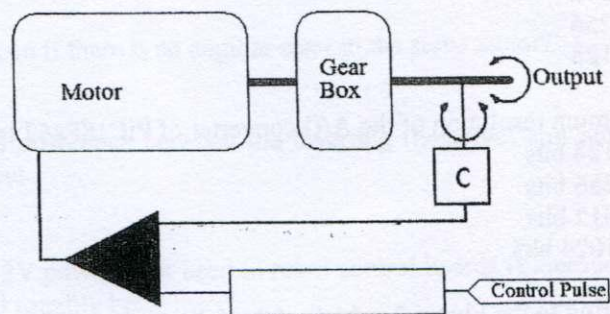


Figure 2

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