UNIVERSITY OF MORATUWA, SRI LANKA
FACULTY OF ENGINEERING

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Sessional Examination (Held in January 2009)
B.Sc. ENGINEERING LEVEL 2, SEMESTER 1

EN 2060 – ROBOT DESIGN AND COMPETITION

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*Answer **ALL** questions in the answer sheet provided.* *Time allowed:* ***90 minutes***
This question paper has 45multiple choice questions on 7 pages

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1. 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 objective
   c. at each step, sensor fusion, world modeling, and planning take place
   d. is not applicable for complex, dynamic environments

2. 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

3. 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

4. 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.

5. A switch sensor can be used for
   a. contact sensing
   b. collision detection
   c. limit rotation
   d. all of them

6. 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

7. 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

8. 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

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

10. The block C in Fig.2 is
   a. position sensor
   b. error amplifier
   c. pulse width to voltage converter
   d. pulse generator

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

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

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

14. When does a motor draw maximum current?
    a. when it starts
    b. when the motion is blocked
    c. when it runs with maximum speed
    d. when it drives its rated load

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

16. The most common small robot controller is
    a. P controller
    b. PD controller
    c. PI controller
    d. PID controller

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

18. 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

19. 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. 15V
    d. 13V

20. 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

9 × 66 / 100

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21. 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

22. 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

23. Proper implementation of pulse width modulation (PWM)
   a. needs 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

24. 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

25. The maximum PWM resolution that can be achieved using a PIC18F452 is
   a. 1024
   b. 512
   c. 256
   d. 128

26. Your motor control board allows 1A. If you want to drive a 2A motor which of the following techniques will you consider 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

27. In Fig.2, if the circuit finds the angle position of the RC servo motor is not correct
   a. the motor shuts off
   b. the motor will turn for 180 degrees
   c. it will always try to minimize the difference between the inverting (negative) and non-inverting (positive) inputs by driving its output
   d. it will stops the pulse width to voltage conversion

28. 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. 25ms
   b. 100us
   c. 50ms
   d. 200us

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

30. Subsumption architecture is not appropriate
   a. for monolithic control loops
   b. when the robot has multiple objectives to achieve
   c. when the environment is dynamic and uncertain
   d. for simple mobile robots

31. Which of the followings is not related to A/D converter in a PIC microcontroller?
   a. select channel
   b. select duty cycle
   c. select voltage reference source
   d. select clock source

32. Which of the following devices can be used for bidirectional dc motor control?
   a. triac
   b. H-bridge
   c. relays
   d. diodes

33. Standard servo pulse period is
   a. 20us
   b. 2ms
   c. 1us
   d. 20ms

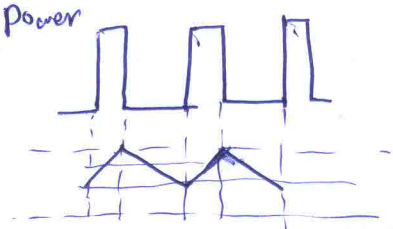
34. How can you use a 9.6V battery to drive 6V servo motor?
   a. do not worry about little extra voltage
   b. use a resister to drop the voltage
   c. not possible
   d. use IN4001 diodes to drop the voltage

35. Which of the followings is not applicable for asynchronous serial transmission?
   a. baud rate
   b. voltage level

c. modulation frequency
d. communication protocol

36. 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



37. What are the parameters that are to be considered for generating a PWM waveform using a microcontroller?

a. duty cycle, frequency, resolution
b. duty cycle, amplitude, resolution
c. phase, duty cycle, resolution
d. resolution, frequency, phase

38. 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

39. The method is used in the development board to protect Motor control IC from the back EMF of the motor is

a. using zenner diodes
b. using voltage regulation
c. using resistors
d. using free-wheeling diodes

40. Which of these statements is not true about servo motors?

a. a servo motor has three wires
b. PWM is used for reference command
c. shaft can be positioned anywhere within 360deg
d. speed control is not allowed

41. A servo system does not generally contain

a. A DC motor
b. A gear reducer
c. a shaft encoder
d. a speed sensor

42. In Fig.2, error amplifier

a. is an operational amplifier with positive feedback
b. always try to minimize the difference between the inverting (negative) and non-inverting (positive) inputs by driving its output to the appropriate direction

c. an electronic circuit which converts pulse width signal to voltage signal
d. a position sensor

43. 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

44. 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 quite good current handling capacity

45. The communication protocol used by the boot loader to communicate with the robot development board is
a. USB
b. RS232
c. RS422
d. RS485

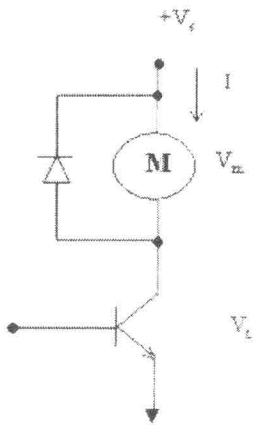


Fig. 1

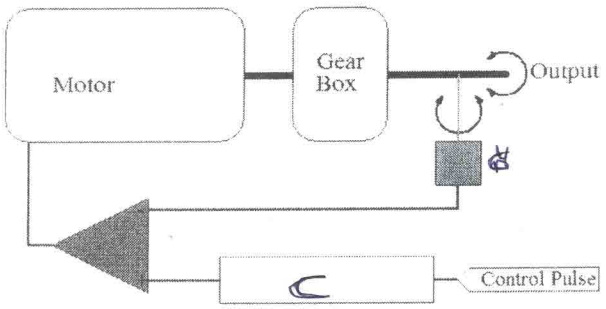


Fig. 2