B.E. (Electronics Engineering / Elect. & Telecommunication /
Elect. & Communication Engineering) Eighth Semester (C.B.S.)

Elective - III : Robotics & Automation

P. Pages : 3

NRJ/KW/17/4695/4706

Time : Three Hours

0246

Max. Marks : 80

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Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.
12. Due credit will be given to explanation with diagrams.

1. a) Two implicit operations are defined as follow : **5**

$$p_1 = (n+1)! \text{ and } p_2 = \frac{(n+2)!}{2}$$

Where $1 \le n \le 6$. If the initial node value is 1, generate an explicit state - space tree using these operations on each node.

b) Using the problem - reduction technique, divide a four - disc pick - and - space (tower of Hanoi) problem into three subproblems, one of which is a primitive problem. **5**

c) What are the two common denominators of an intelligent robot? **3**

OR

2. a) What are synapses and how do they respond like digital gates to nerve impulses? **4**

b) List several characteristics of the human brain. List several characteristics of digital computers. **5**

c) Describe the difference between forward & backward reasoning and state where each type of reasoning is used. **4**

3. a) A domestic robot sounded an alarm when it detected an intruder in the basement of a house. The robot detected a sound that was created by a window breaking in the basement. The sound could be heard throughout the house when the police arrived, they found a person in the basement. The person told the police that he did not hear the window break and therefore could not be the suspected intruder. **9**

b) Given the two propositions : **5**
   i) A chicken is a bird.
   ii) If a creature is a bird, then it has wings.
   What logic rule of inference allows you to say that "A chicken has wings?"

OR

4. a) What is the major reason that production systems are popular, especially in expert systems? **4**

b) Define an expert system. What type of knowledge representation is utilized by most expert systems? **5**

c) List at least three commercial expert systems and their respective application areas. **5**

5. a) Describe the difference between a voiced fricative and an unvoiced fricative. List at least three examples of each sound. **4**

b) List the features of speech that convey meaning to a word or phrase. **4**

c) Describe the major functional regions of a speech synthesizer that is designed to operate using the LPC code. **5**

OR

6. a) Suppose an 8-bit A/D converter is used to sample a speech waveform at a rate of 5000 samples per second. **5**
    a) Calculate the data rate.
    b) How many bytes of memory are required to store 10 seconds of speech with simple PCM?
    c) How many bytes of memory are required to store 10 seconds of speech using delta modulation?
    d) How many bytes of memory are required to store 10 seconds of speech using a 6-bit DPCM system and the same sampling rate?
    e) How many bytes of memory are required to store 10 seconds of speech using a 3-bit ADPCM system and the sampling rate?

b) Describe the fundamental differences between PCM, delta modulation, DPCM and ADPCM. **8**

7. a) Construct an 8 x 8 picture matrix for the letter A using a four bit gray scale code. Smooth this matrix using local-averaging technique and a 3 x 3 pixel window. Generate a binary matrix from this smoothed gray scale matrix. Use the Robert's operator Thresholding technique with a threshold value of 4. **6**

b) Name and explain the main tasks that must be performed by an intelligent vision system. **4**

c) Explain how shadows and cracks can enhance the image understanding process. **4**

OR

8. a) Explain the operating principle of a CCD camera. **5**

b) Construct an 8 x 8 picture matrix for the letter A using a 4 - bit gray - scale code. Smooth the matrix you constructed using the local - averaging technique and 3 x 3 pixel window. **5**

c) What is a picture tree and why is it useful? **4**

9. a) A stereo vision system employs two TV cameras whose local length is 10 cm and that are located 20 cm apart. Two corresponding pixel points are located 1 cm from their respective lens centers. Calculate the range to an object if the disparity between the two stereo images is 2 cm. **5**

b) A burst of ultrasound takes 5 ms to reach and return from an object. What is the range, in feet, of the object? **4**

c) Explain how capacitance can be used for proximity sensing. **4**

OR

10. a) A commercial ultrasonic range finder is used with a 100 - K - Hz, 8 - bit counter. What is the maximum range of the system. **5**

b) List the ideal properties of a touch sensor. **5**

c) Name the three fundamental sensing operations of a tactile system. **3**

11. a) List various robot programming languages & explain their characteristics in brief. **6**

b) Explain how sensing is carried out in robot programming. List the types of commands used for each one of them. **7**

OR

12. a) Write an AL statement for defining a coordinate frame grasp which can be obtained by rotating the coordinate frame block through an angle of 65° about the y - axis and then translating it 4 and 6 inches in the x and y axes respectively. **7**

b) Write an AL program to palletize nine parts from a feeder to a tray consisting of a 3 x 3 array of bins. Assume that the locations of the feeder and tray are known. The program has to index the location for each pallet and signal the user when the tray is full. **6**

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