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

Elective-III : Robotics & Automation

P. Pages : 3 **NRT/KS/19/3639/3650**

Time : Three Hours * 0 7 9 4 * Max. Marks : 80

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. Assume suitable data whenever necessary.
9. Illustrate your answers whenever necessary with the help of neat sketches.
10. Use of non programmable calculator is permitted.

1. a) Two implicit operators are defined as follows : **5**

$P_1 = (n+1)!$ 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.

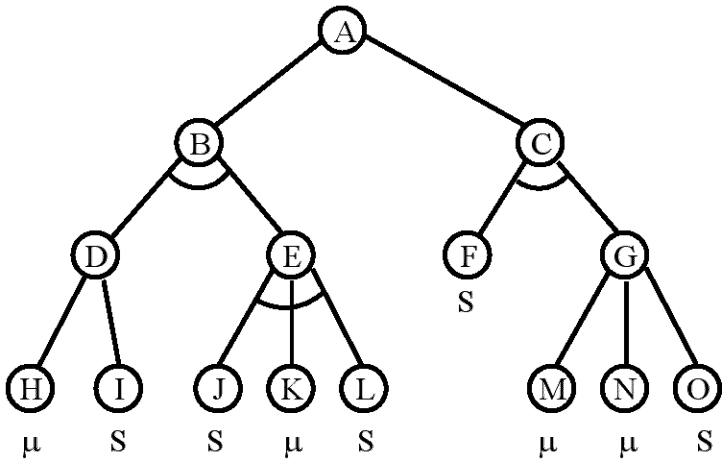
b) Using the problem reduction technique, divide a four-disk pick and place (tower of Hanoi) problem into three sub problems one of which is a primitive problem. **5**

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

OR

2. a) Explain Blind searches in detail. **9**

b) Given the AND/OR tree shown in figure below. The letter S beneath a primitive node means that the node is solved, while the letter be means that the node is unsolvable. Does a solution path exists ? If so, sketch the solution subgraphs. **4**



3. a) Explain the difference between propositional and predicate logic. **4**

b) Prove that $\overline{A \cup B} = \overline{A} \cap \overline{B}$ **5**

c) Prove that $A \forall B = A \cdot \overline{B} \cup \overline{A} \cdot B$ **5**

OR

4. a) What are three major parts of production system ? Explain each in detail. **7**

b) Explain in detail the three major operating modes of an expert system. **7**

5. a) Explain the linear predictive coding method for frequency domain analysis synthesis. **7**

b) What design criteria must be considered when designing a speech recognition or speech understanding system ? **6**

OR

6. a) Describe the fundamental differences between PCM, delta modulation, DPCM & ADPCM. **9**

b) Suppose an 8 bit A/D converter is used to sample a speech waveform at a rate of 5000 samples per second. **4**

i) Calculate the data rate

ii) How many bytes of memory are required to store 10 seconds of speech using delta modulation.

7. a) Constant 8 x 8 picture matrix - **9**

i) For letter A using a 4 bit gray scale code.

ii) Smooth the matrix you constructed in part (i) using the local averaging technique and a 3 x 3 pixel window.

iii) Generate a binary matrix from your smoothed gray-scale matrix in part (ii). Use Roberts operator thresholding technique with a threshold value of 4.

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

OR

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

b) Describe the three levels of design difficulty that apply to industrial vision system. **8**

9. a) Name at least three forms of active triangulation and explain any two in detail. **7**

b) i) A burst of ultrasound takes 5 ms to reach and return from an object. What is the range in feet of the object. **7**

ii) What is the range of the object if laser light is substituted for ultrasound in part (i)

OR

10. a) A stereo vision system employs two TV cameras, whose focal 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 two stereo images is 2 cm. **5**

b) A commercial ultrasonic range finder is used with a 100 kHz. 8 bit counter what is the maximum range of the system ? **5**

c) List the ideal properties of a touch sensor. **4**

11. a) Write an AL statement for defining a co-ordinate 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) List various robot programming languages and explain their characteristics in brief. **6**

OR

12. a) Explain how sensing is carried out in robot programming. List the types of commands used for each one of them. **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 location of the feeder and tray are known. The program has to index the location for each pallet and signaling the user when the tray is full. **6**

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