REG.NO.: 23BAI0017

SLOT: D2+TD2

VIT

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING
CONTINUOUS ASSESSMENT TEST - II
WINTER SEMESTER 2025-2026

Programme Name & Branch	**: B.Tech, CSE**
Course Code and Course Name	**: BCSE417L, Machine Vision**
Faculty Name(s)	**: Prof. Anisha M Lal, Prof. Dheeba J**
Class Number(s)	**: 1993, 1995**
Date of Examination	**: 18/03/26**
Exam Duration	**: 90 minutes** **Maximum Marks: 50**

General instruction(s):

Answer All Questions

M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Course Outcomes

CO2 Enhance, Analyze and segment the image using algorithms

CO3 To interpret the image and transform it using the mathematical knowledge

CO4 Extract the features from the image and represent using morphological operations

<table>
<tr><th>Q. No</th><th>Question</th><th>M</th><th>CO</th><th>BL</th></tr>
<tr><td>1.</td><td>Apply the morphological skeleton definition $S(A) = \bigcup_{k=0}^{K} S_k(A)$, on the below given image 'A' using the structuring element 'B' for all valid iterations until the image reduces to an empty set. Also, explain why the skeleton tends to lie equidistant from the boundaries of the object.
A =
0 1 1 1 1 1 0 0
0 1 1 1 1 1 0 0
0 0 0 1 1 0 0 0
0 0 0 1 1 1 0 0
0 0 0 1 1 1 0 0
0 0 0 1 1 1 0 0
0 0 0 1 1 1 0 0
0 0 0 1 1 1 0 0
B =
0 1 x
0 1 1
x 1 x</td><td>10</td><td>4</td><td>3</td></tr>
<tr><td>2.</td><td>Analyse the statistical texture properties of the below 4x4 gray scale image by computing the gray level co-occurrence matrix $P(i,j)$ for $\theta = 45^0$.
1 1 2 2
3 3 0 0
2 1 1 2
3 0 3 0
a. Normalize the GLCM and compute entropy and inertia.
b. What would happen to the feature vectors if the image had a completely uniform intensity region? Justify.</td><td>10</td><td>4</td><td>4</td></tr>
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3.	An image of 5x5 is processed in the frequency domain. Design a high pass filter using the butterworth low pass filter with a cutoff frequency, $D_0 = 2$ and order of the butterworth filter, $n = 2$ to process the image. Comment on the effect of applying a low pass filter with a very small cutoff frequency.	10	3	6
4.	Consider the 4x4 image below and assume that the indices start from (0,0). 1 1 1 1 1 0 1 0 1 0 1 0 1 0 1 0 a. Use discrete fourier transform to convert the given spatial domain image to frequency domain image. b. With an example prove that multiplication of image by $(-1)^{x+y}$ in spatial domain causes the shifting of low frequency to the middle of fourier spectrum.	10	3	3
5.	A medical imaging system needs to segment a tumor region from a single MRI brain scan. The radiologist manually places an initial contour near the suspected tumor boundary. The system then evolves this contour to accurately fit the true boundary of the tumor. a. Explain how the contour is updated using image gradients and curvature constraints. b. Give the energy function used in contour evolution and explain. c. Discuss two limitations of this approach in noisy images.	10	2	4

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WINTER SEMESTER 2025-2026

	The given image is processed in the frequency domain using a Gaussian Low Pass Filter with a cut-off frequency of $D_0 = 2$. a) Write the mathematical expression for the Gaussian Low Pass Filter transfer function. b) Compute the distance matrix $D(u, v)$ for the 5×5 frequency grid assuming the origin is at the center (2,2). c) Using $D_0 = 2$, compute the Gaussian Low Pass Filter mask $H(u, v)$ for the 5×5 grid.			
3.	Consider the given 5×5 grayscale image, $f(x,y) = \begin{bmatrix} 10 & 12 & 15 & 12 & 10 \\ 12 & 18 & 20 & 18 & 12 \\ 15 & 20 & 25 & 20 & 15 \\ 12 & 18 & 20 & 18 & 12 \\ 10 & 12 & 15 & 12 & 10 \end{bmatrix}$. The given image is processed in the frequency domain using a Gaussian Low Pass Filter with a cut-off frequency of $D_0 = 2$. d) Write the mathematical expression for the Gaussian Low Pass Filter transfer function. e) Compute the distance matrix $D(u, v)$ for the 5×5 frequency grid assuming the origin is at the center (2,2). f) Using $D_0 = 2$, compute the Gaussian Low Pass Filter mask $H(u, v)$ for the 5×5 grid.	10	3	3
4.	Construct the Haar transform kernel and apply it to a 2×2 image matrix to obtain the transformed coefficients. Explain the steps involved in the process. Also, demonstrate the Haar Transform kernel operation using the given 2×2 image, $I = \begin{bmatrix} 6 & 2 \\ 8 & 4 \end{bmatrix}$	10	3	6
5.	By considering the *given* 5×5 grayscale image, $I = \begin{bmatrix} 45 & 50 & 55 & 60 & 65 \\ 40 & 48 & 52 & 58 & 63 \\ 38 & 42 & 50 & 55 & 60 \\ 35 & 40 & 45 & 52 & 58 \\ 30 & 35 & 40 & 48 & 54 \end{bmatrix}$ a) Compute *the* LBP code for the center pixel (50) using the 8-neighborhood $LBP_{8,1}$ operator. Clearly show the thresholding and binary pattern formation. b) Discuss how uniform LBP patterns are used for texture classification and face recognition applications.	10	4	3

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CONTINUOUS ASSESSMENT TEST - II
WINTER SEMESTER 2025-2026

Programme Name & Branch	**: B.Tech CSE**
Course Code and Course Name	**: BCSE417L - Machine Vision**
Faculty Name(s)	**: Dr. Aju D**
Class Number(s)	**: VL2025260501869**
Date of Examination	**: 18th March 2026**
Exam Duration	**: 90 minutes** **Maximum Marks: 50**

General instruction(s):

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes: (Type the CO statements covered in this question paper. Use the CO number as per the syllabus copy)

Q. No	Question	M	CO	BL
1	Consider a directed graph G=(V,E) with six vertices S,A,B,C,D,T. The edge capacities are given below. S -> A =10; S -> B = 8; A -> C =5; A -> D = 4; B -> C = 3; B -> D = 6; C -> T = 8 and D -> T = 7 1. Draw the directed flow network based on the given edges and the respective weights. 2. Compute the maximum flow from S to T. 3. Determine the min-cut of the network. 4. Verify the Max-flow Min-Cut Theorem for the given graph.	10	2	4
1.	By considering the given binary image A and structuring element B, perform the following tasks. $A = \begin{bmatrix} 0 & 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 & 0 \end{bmatrix}$ $B = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 1 & 1 \\ 0 & 1 & 0 \end{bmatrix}$ a) Compute the first two iterations of erosion $A \ominus B$ and $A \ominus 2B$. b) Determine the corresponding skeleton subsets $S_0(A)$ and $S_1(A)$. c) Illustrate the resulting skeleton pixels obtained from these iterations. d) What property of morphological erosion causes the skeleton to form along the central regions of the object? Briefly explain.	10	2	3
2.	*Consider the given* 5×5 grayscale image, $f(x,y) = \begin{bmatrix} 10 & 12 & 15 & 12 & 10 \\ 12 & 18 & 20 & 18 & 12 \\ 15 & 20 & 25 & 20 & 15 \\ 12 & 18 & 20 & 18 & 12 \\ 10 & 12 & 15 & 12 & 10 \end{bmatrix}$.			