

Roll Number: \_\_\_\_\_

**Thapar Institute of Engineering and Technology (TIET), Patiala**  
**Department of Computer Science & Engineering (CSED)**  
**MID SEMESTER EXAMINATION**

B. E. (Third Year): Semester-V (2023-24) (COE/CSE)	Course Code: UCS532 Course Name: Computer Vision
September 25, 2023	Monday, 03:00 – 05:00 PM
Time: 02.00 Hrs, Max. Marks: 35	Name of Faculty: Dr. Shailendra Tiwari

**Note: Attempt all questions in sequence. Assume suitable values for missing data.**

Q. 1	<p>(a) Give at least <b>four</b> practical real-time applications of computer vision. Also, elaborate on <b>two</b> key challenges that contribute to the complexity of computer vision? [6]</p> <p>(b) As most of you may know images are formed when a light source hits the surface of an object and the light is reflected onto an image plane which is then captured through optics on to a sensor plane. Could you enumerate at least <b>four</b> factors that affects the image formation process? [4]</p>																																		
Q. 2	<p>(a) Consider a <math>5 \times 5</math> image <math>f(x, y)</math> as an input of <i>three</i> bit intensity level as shown below in Fig. 1. Find the output <math>g(x, y)</math> as a Histogram Equalized image. [5]</p> <table border="1"><tr><td>1</td><td>6</td><td>4</td><td>3</td><td>4</td></tr><tr><td>1</td><td>1</td><td>1</td><td>7</td><td>6</td></tr><tr><td>6</td><td>6</td><td>3</td><td>3</td><td>1</td></tr><tr><td>2</td><td>2</td><td>1</td><td>5</td><td>2</td></tr><tr><td>1</td><td>1</td><td>6</td><td>5</td><td>2</td></tr></table> <p style="text-align: center;">Fig. 1</p> <p>(b) Fig. 2 is an example of <math>3 \times 3</math> Laplacian of Gaussian filter (LOG). Could you elucidate the process by which this filter was derived? [5]</p> <table border="1"><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>-4</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td></tr></table> <p style="text-align: center;">Fig. 2</p>	1	6	4	3	4	1	1	1	7	6	6	6	3	3	1	2	2	1	5	2	1	1	6	5	2	0	1	0	1	-4	1	0	1	0
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Q. 3	<p>(a) Consider the filter <math>f = [1, 2, 1]</math> and the 1D image <math>I = [0, 1, 2, 3, 3, 3, 1, 3, 6]</math>. What is the result by convolving <math>f * I</math>? Pad the image with zeros at the boundaries if necessary. [4]</p> <p>(b) To what extent does the Fourier Transform Convolution Theorem enhance cost efficiency, taking into consideration an image size of <math>N \times N</math> and a kernel size of <math>k \times k</math>? Show your response using Big-O notation to indicate the time complexity. [2]</p> <p>(c) Find the gradient of a function <math>f(x, y) = 3x^2 + 2y + 6</math> at <math>(1, -1)</math>. [4]</p>																																		
Q. 4	<p>Compute the spatial coefficient value <math>f(x)</math> for a given 1D Fourier Transform <math>F(u) = [11, -3 + 2j, -1, -3 - 2j]</math>. [5]</p>																																		

The schedule of showing the evaluated answer sheets will be shown on the course website <https://ada-lms.thapar.edu/moodle/course/view.php?id=1824>