



# LABORATORY WORKBOOK

19CS3271R PERCEPTION AND  
COMPUTER VISION





## LABORATORY WORKBOOK

STUDENT NAME	
REG. NO	
YEAR	
SEMESTER	
SECTION	
FACULTY	

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## **Organization of the STUDENT LAB WORKBOOK**

The laboratory framework includes a creative element but shifts the time-intensive aspects outside of the Two-Hour closed laboratory period. Within this structure, each laboratory includes three parts: Pre-lab, In-lab, and Post-lab.

### **a. Pre-Lab**

The Pre-lab exercise is a homework assignment that links the lecture with the laboratory period - typically takes 2 hours to complete. The goal is to synthesize the information they learn in lecture with material from their textbook to produce a working piece of software. Pre-lab Students attending a two-hour closed laboratory are expected to make a good-faith effort to complete the Pre-lab exercise before coming to the lab. Their work need not be perfect, but their effort must be real (roughly 80 percent correct).

### **b. In-Lab**

The In-lab section takes place during the actual laboratory period. The First hour of the laboratory period can be used to resolve any problems the students might have experienced in completing the Pre-lab exercises. The intent is to give constructive feedback so that students leave the lab with working Pre-lab software - a significant accomplishment on their part. During the second hour, students complete the In-lab exercise to reinforce the concepts learned in the Pre-lab. Students leave the lab having received feedback on their Pre-lab and In-lab work.

### **c. Post-Lab**

The last phase of each laboratory is a homework assignment that is done following the laboratory period. In the Post-lab, students analyze the efficiency or utility of a given system call. Each Post-lab exercise should take roughly 120 minutes to complete.



**2020-21 EVEN SEMESTER LAB CONTINUOUS EVALUATION**

Sl No	Date	Experiment Name	PreLab (5M)	In-Lab (40M)				Post-Lab (5M)	Viva Voce (5M)	Total (50M)	Faculty Signature
				LOGIC (10M)	EXECUTION (10M)	RESULT (10M)	ANALYSIS (5M)				
1.											
2.											
3.											
4.											
5.											
6.											

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7.											
8.											



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Sl No	Date	Experiment Name	PreLab (5M)	IN-LAB (40M)				Post-Lab (5M)	Viva - Voc e (5M )	Total (50M )	Faculty Signature
				LOGIC (10M)	EXECUTION (10M)	RESULTS (10M)	ANALYSIS (5M)				
9.											
10.											
11.											
12.											
13.											
14.											

**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**  
**SUBJECT CODE: 19CS3271R**  
**PERCEPTION AND COMPUTER VISION**

**PRACTICAL-1: Basic Operations on Images Using OpenCV and Python**

Date of the Session: \_\_\_\_/\_\_\_\_/\_\_\_\_

Time of the Session: \_\_\_\_ to \_\_\_\_

**PRE-LAB TASK:**

1. What is computer vision?
2. Give some industrial applications of computer vision?

**3.** Why should we deal with images in computer vision?

**4.** What is Bayer color filter array?

**IN-LAB TASK:**

1. Perform a program for loading an image in an unchanged, color, gray mode and display them until you press 'a' using OPENCV.  
Also Write a code to save the three images using OPENCV.

2. Harry is applying to university and to follow the admission process he needs to upload three types of certificates for which the conditions given below. So, help Harry to do his task. First, select an image of a certificate and then perform the following operations:
- Resize to specific width (450) and height (550)
  - Resize only height (450)
  - Downscale with resize ()

3. Implement a code to perform blending operation on two images in which have 60% of image1 and 40% of image2.

**POST LAB:**

1. Danil wants to create an interactive Chatbot of color filter in which it must perform the following operations and the chatbot must ask whether the image is required to be saved after performing the corresponding task.
  - [1] Hue
  - [2] Saturation
  - [3] HSV Image
  - [4] Value
  - [5] Green Channel
  - [6] Doubled image

<p><b><u>LAB-1: Comment of the Evaluator (Tick appropriate else write below)</u></b></p> <ul style="list-style-type: none"> <li>• Coding standard is poor. Considerable improvement on coding quality needed</li> <li>• Coding standard is good. Improve on finer aspects of coding.</li> <li>• Work shows gross negligence. Pay more attention to improve overall work quality</li> <li>• Improve on theoretical foundations required to solve the implementation</li> </ul> <p>Other:</p>	<p><u>Evaluator's Observation:</u></p> <p>Marks Secured: _____ out of _____</p> <p>Full Name of the Evaluator:</p> <p>Signature of the Evaluator      Date of Evaluation:</p>
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**PRACTICAL-2: Color Image Processing Using OpenCV and Python**

Date of the Session: \_\_\_\_/\_\_\_\_/\_\_\_\_

Time of the Session: \_\_\_\_ to \_\_\_\_

**PRE-LAB TASK:**

1. How is an RGB image represented? How many channels are there in an RGB image?
2. What are the ranges of pixel intensities for each of these channels?
3. What are color-spaces ?

**4. Describe the following color-spaces.**

- i) YCrCb Color Space
- ii) HSV color space
- iii) LAB color space
- iv) CMYK color space
- v) BGR Color Space
- vi) Edge map of image
- vii) Heat map of image
- viii) Spectral Image map



**IN-LAB TASK:**

Perform the following operations programmatically using OpenCV and python: Comment your code as much as possible.

1. Read an input color (RGB) image
2. Convert the read image to YCrCb color space
3. Convert the read image to HSV color space
4. Convert the read image to LAB color space
5. Compute the edge map of the read image using Laplacian
6. Compute the heat map of the read image
7. Compute the spectral image map of the read image

**POST LAB:**

1. Compute the image mask of the input (read) image you used in the IN-LAB TASK.
2. Now superimpose the color image on top of the mask image and display the result

3. Plot the resulting histograms of the original color input image, the computed mask image and the superimposed (mask+color) images.

<p><b><u>LAB-2: Comment of the Evaluator (Tick appropriate else write below)</u></b></p> <ul style="list-style-type: none"> <li>● Coding standard is poor. Considerable improvement on coding quality needed</li> <li>● Coding standard is good. Improve on finer aspects of coding.</li> <li>● Work shows gross negligence. Pay more attention to improve overall work quality</li> <li>● Improve on theoretical foundations required to solve the implementation</li> </ul> <p>Other:</p>	<p><u>Evaluator's Observation:</u></p>  <p>Marks Secured: _____ out of _____</p> <p>Full Name of the Evaluator:</p> <p>Signature of the Evaluator      Date of Evaluation:</p>
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**PRACTICAL-3: Video Preprocessing Techniques Using OpenCV and Python**

Date of the Session: \_\_\_\_/\_\_\_\_/\_\_\_\_

Time of the Session: \_\_\_\_ to \_\_\_\_

**PRE-LAB TASK:**

1. What is the difference between image and videos?
2. When do we use `cv2.waitKey(0)` and `cv2.waitKey(1)`?



3. Define the terms Frame Rate and Resolution?

4. What is a *codec* and give a few examples of *codec*?

**IN-LAB TASK:**

1. Jessy once visited the cctv room of her college. Then she saw the Live Video Feed Capture of her entire college and she also became interested in Live Video Feed from Camera.  
so help her in implementing the following requirements

1. Start a Live Video Feed Capture from Camera or Webcam
2. Create two Windows Both should display The Live Video Feed from camera
3. Window 1. It should be color Video
4. Window 2. It should be gray Scale and upside down i.e inverted
5. Also Both of these windows should display the Date and Current time
6. Here the Live Feed should stop as soon as you enter a character 'q'
7. Also save the Window 1 video as two ".avi" file. one file should be slow speed of video playback -and other one should be high speed of video playback



**POST-LAB:**

Now Jessy wants to implement Live Video Feed Capture and create window which will zoom in and zoom out the live video and also rotate(360 degrees) the window continuously.

<p><b><u>LAB-2: Comment of the Evaluator (Tick appropriate else write below)</u></b></p> <ul style="list-style-type: none"> <li>• Coding standard is poor. Considerable improvement on coding quality needed</li> <li>• Coding standard is good. Improve on finer aspects of coding.</li> <li>• Work shows gross negligence. Pay more attention to improve overall work quality</li> <li>• Improve on theoretical foundations required to solve the implementation</li> </ul> <p>Other:</p>	<p><u>Evaluator's Observation:</u></p> <p>Marks Secured: _____ out of _____</p> <p>Full Name of the Evaluator:</p> <p>Signature of the Evaluator      Date of Evaluation:</p>
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**PRACTICAL-4: Edge Detection and Region Of Interest Using OpenCV and Python**

Date of the Session: \_\_\_\_/\_\_\_\_/\_\_\_\_

Time of the Session: \_\_\_\_ to \_\_\_\_

**PRE-LAB TASK:**

1. Explain the operations done in edge detection in detail?

2. Explain Region of Interest (ROI)?

3. How many types of edges in image and why should we detect?

4. When should we use ROI?

### **IN-LAB TASK:**

1. Kushal is taking an extra class for edge detection there he got a work from his teacher to do all the task below. Kushal alone can't do so help him to complete his work
  - i. Load the image.
  - ii. Convert the image into grayscale.
  - iii. Apply the gaussian blur to the image.
  - iv. Now apply the edge detection algorithm for the image.
  - v. Then display the detected image.
  
2. Rurik and Kamal are friends. Rurik wants to crop an image and in which the region of image should selected by kamal and then rurik would like to show that selected region separated from original to kamal.





**POST-LAB TASK:**

Charles is a portrait painting artist. He wants to replicate a picture so he wants to know the total number of edges present in the picture. Can you help him find the number of edges in the picture with the help of edge detection.

<p><b><u>LAB-4: Comment of the Evaluator (Tick appropriate else write below)</u></b></p> <ul style="list-style-type: none"> <li>● Coding standard is poor. Considerable improvement on coding quality needed</li> <li>● Coding standard is good. Improve on finer aspects of coding.</li> <li>● Work shows gross negligence. Pay more attention to improve overall work quality</li> <li>● Improve on theoretical foundations required to solve the implementation</li> </ul> <p>Other:</p>	<p><u>Evaluator's Observation:</u></p> <p>Marks Secured: _____ out of _____</p> <p>Full Name of the Evaluator:</p> <p>Signature of the Evaluator      Date of Evaluation:</p>
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**PRACTICAL-5: Image Thresholding and Geometric Transformations of Images using OpenCV and Python**

Date of the Session: \_\_\_\_/\_\_\_\_/\_\_\_\_

Time of the Session: \_\_\_\_ to \_\_\_\_

**PRE-LAB TASK:**

1. Mention the different types of thresholding techniques?

2. Mention the role of gui in real world?

### 3. Why is adaptive thresholding used in practice?

4. Attribute the reasons for using otsu thresholding?

**IN-LAB TASK:**

Create a Graphical User Interface using Tkinter as given below and this interface must take an image '.jpg or .png file' and it should perform Thresholding and Adaptive Thresholding .so create

Various buttons like BINARY,BINARY\_INV,TOZERO,TOZERO\_INV,TRUNC,MEAN\_C and GAUSSIAN\_C. Here after pressing the button the algorithm must be implemented on the image and give resultant image on the new window





**POST-LAB TASK**

1. Jackson is a mathematician guy now he wants to apply tricks on image like he wants to rotate the image along all angles continuously until we press 'q' button in keyboard. So help him to perform his task using OPENCV?

<p><b><u>LAB-5: Comment of the Evaluator (Tick appropriate else write below)</u></b></p> <ul style="list-style-type: none"> <li>• Coding standard is poor. Considerable improvement on coding quality needed</li> <li>• Coding standard is good. Improve on finer aspects of coding.</li> <li>• Work shows gross negligence. Pay more attention to improve overall work quality</li> <li>• Improve on theoretical foundations required to solve the implementation</li> </ul> <p>Other:</p>	<p><u>Evaluator's Observation:</u></p> <p>Marks Secured: _____ out of _____</p> <p>Full Name of the Evaluator:</p> <p>Signature of the Evaluator      Date of Evaluation:</p>
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## **PRACTICAL-6: Image Denoising Techniques Using OpenCV and Python**

Date of the Session: \_\_\_\_/\_\_\_\_/\_\_\_\_

Time of the Session: \_\_\_\_ to \_\_\_\_

### **PRE-LAB TASK**

1. What is Image denoising?

2. Mention some image denoising techniques ?



3. For Grayscale images which image denoising method is used?

4. For color image which image denoising method is used?

### **IN-LAB TASK:**

Harsha took pictures on his trip to mumbai in which few pictures were blurred, he wants to unblur the pictures using image denoising ,Guys can you help harsha in implementing image denoising.

Harsha has four types of pictures.they are

- (i) Grayscale image
- (ii) Color image
- (iii )Grayscale image captured in a short period of time(use video capturing and take first 5 frames)
- (iv) Color image captured in a short period of time(use video capturing and take first 5 frames)



## **POST-LAB TASK**

- 1.State and explain the applications of denoising.
- 2.Compare gaussian noise to salt and pepper noise.

3. Plot and compare the histograms of the original noisy and the denoised images.

<p><b><u>LAB-6: Comment of the Evaluator (Tick appropriate else write below)</u></b></p> <ul style="list-style-type: none"> <li>● Coding standard is poor. Considerable improvement on coding quality needed</li> <li>● Coding standard is good. Improve on finer aspects of coding.</li> <li>● Work shows gross negligence. Pay more attention to improve overall work quality</li> <li>● Improve on theoretical foundations required to solve the implementation</li> </ul> <p>Other:</p>	<p><u>Evaluator's Observation:</u></p> <p>Marks Secured: _____ out of _____</p> <p>Full Name of the Evaluator:</p> <p>Signature of the Evaluator      Date of Evaluation:</p>
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**PRACTICAL-7: Histogram Equalization Using OpenCV and Python**

Date of the Session: \_\_\_\_/\_\_\_\_/\_\_\_\_

Time of the Session: \_\_\_\_ to \_\_\_\_

**PRE-LAB TASK:**

1. What is an image histogram and why it is useful ?

2. What is histogram equalization?

3. Write the pseudo-code for histogram equalization.
4. Discuss some applications of histogram equalization.



**IN LAB:**

Solve the following questions programatically using opencv and python.

1. Apply histogram equalization using the *equalizeHist* function.
2. Solve the problem of over-brightness using the adaptive histogram equalization by using the OpenCV *CLAHE* method.



**POST-LAB TASK:**

1. Discuss at least two differences between the *equalizeHist* method and the *CLAHE* method of histogram equalization.
2. Plot the histogram of the original image, the histogram of the histogram-equalized image using the *equalizehist* function, and the histogram of the image after applying the *CLAHE* method.



3. Analyze the three histograms in question 2 of post-lab and discuss the differences between them.

<p><b><u>LAB-7: Comment of the Evaluator (Tick appropriate else write below)</u></b></p> <ul style="list-style-type: none"> <li>• Coding standard is poor. Considerable improvement on coding quality needed</li> <li>• Coding standard is good. Improve on finer aspects of coding.</li> <li>• Work shows gross negligence. Pay more attention to improve overall work quality</li> <li>• Improve on theoretical foundations required to solve the implementation</li> </ul> <p>Other:</p>	<p><u>Evaluator's Observation:</u></p> <p>Marks Secured: _____ out of _____</p> <p>Full Name of the Evaluator:</p> <p>Signature of the Evaluator      Date of Evaluation:</p>
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**PRACTICAL-8: Masking and Segmentation Using OpenCV**  
**and Python**

Date of the Session: \_\_\_\_/\_\_\_\_/\_\_\_\_

Time of the Session: \_\_\_\_ to \_\_\_\_

**PRE-LAB:**

[1] What is Image Segmentation?

[2] Why is image masking used?

[3] What are the different types of Image segmentation techniques?

[4] Describe and explain the watershed algorithm?

**IN LAB:**

Kishore and varun are students of K L University they were willing to implement masking technique that is to detect the blue color object using Webcam. Help Kishore and Varun to implement image masking using python and openCV?



**POST LAB:**

[1] Apply image denoising and histogram equalization to the resulting masked image. Is there any noticeable change? Explain.

[2] Compare and contrast the different methods available for image segmentation.

<p><b><u>LAB-8: Comment of the Evaluator (Tick appropriate else write below)</u></b></p> <ul style="list-style-type: none"> <li>● Coding standard is poor. Considerable improvement on coding quality needed</li> <li>● Coding standard is good. Improve on finer aspects of coding.</li> <li>● Work shows gross negligence. Pay more attention to improve overall work quality</li> <li>● Improve on theoretical foundations required to solve the implementation</li> </ul> <p>Other:</p>	<p><u>Evaluator's Observation:</u></p> <p>Marks Secured: _____ out of _____</p> <p>Full Name of the Evaluator:</p> <p>Signature of the Evaluator      Date of Evaluation:</p>
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**PRACTICAL-9: K-means Clustering for Color Quantization Using OpenCV**

Date of the Session: \_\_\_\_/\_\_\_\_/\_\_\_\_

Time of the Session: \_\_\_\_ to \_\_\_\_

**PRE-LAB TASK:**

1. What Is Color Quantization?
2. State the main reasons for performing color quantization?

3. Why do we use K-Means Clustering for color quantization?

4. Write the formula for Euclidean distance for two RGB colors?

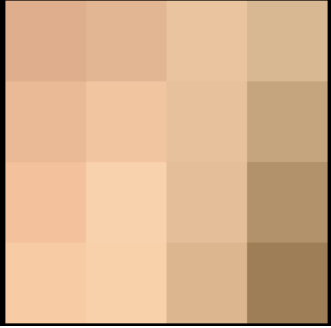
## IN-LAB TASK:

Two Best Friends Named Ramesh and Rajesh were thinking to reduce the number of colors in an image but they were not familiar with that. Help them to implement the *Color Quantization* with OPENCV Using *K means clustering* algorithm for the given image where K value is 3?



**POST-LAB TASK:**

The two friends were satisfied for the Color Quantization which you had performed but they had doubt regarding how it was actually implemented. Demonstrate to them by doing this manually.



Representing the above pixel image as numpy array:

(216, 175, 145)	(220, 183, 152)	(228, 197, 164)	(210, 184, 151)
(227, 186, 154)	(235, 198, 165)	(225, 194, 161)	(192, 165, 131)
(236, 195, 161)	(242, 211, 178)	(222, 191, 158)	(173, 146, 112)
(241, 204, 168)	(242, 210, 175)	(214, 183, 147)	(153, 127, 91)

Perform Certain Operations Manually:

1. Identify the number of clusters you need — ‘K’'s value.
2. Select ‘K’ points (centers) within the range of the items in the list
3. Calculate distances of all items to each ‘K’ center.
4. Classify each items to a center with the shortest distance





<p><b><u>LAB-9: Comment of the Evaluator (Tick appropriate else write below)</u></b></p> <ul style="list-style-type: none"> <li>● Coding standard is poor. Considerable improvement on coding quality needed</li> <li>● Coding standard is good. Improve on finer aspects of coding.</li> <li>● Work shows gross negligence. Pay more attention to improve overall work quality</li> <li>● Improve on theoretical foundations required to solve the implementation</li> </ul> <p>Other:</p>	<p><u>Evaluator's Observation:</u></p> <p>Marks Secured: _____ out of _____</p> <p>Full Name of the Evaluator:</p> <p>Signature of the Evaluator      Date of Evaluation:</p>
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Date of the Session: \_\_\_\_/\_\_\_\_/\_\_\_\_  
Time of the Session: \_\_\_\_ to \_\_\_\_

## 1. What are morphological transformations?

2. Explain the following morphological operations
- i) Erosion
  - ii) Dilation
  - iii) Opening
  - iv) Closing
  - v) Morphological gradient



### **IN-LAB TASK:**

Perform the following morphological operations programatically using python and opencv:

- i) Erosion
- ii) Dilation
- iii) Opening
- iv) Closing
- v) Morphological gradient
- vi) Top Hat
- vii) Black Hat





**POST-LAB TASK:**

1. Plot the histogram of each morphed image (7 morphological operations) in the IN-LAB TASK activity.
2. Explain the differences between these histograms.
3. State the applications of these morphological operations

<p><b><u>LAB-10: Comment of the Evaluator (Tick appropriate else write below)</u></b></p> <ul style="list-style-type: none"> <li>● Coding standard is poor. Considerable improvement on coding quality needed</li> <li>● Coding standard is good. Improve on finer aspects of coding.</li> <li>● Work shows gross negligence. Pay more attention to improve overall work quality</li> <li>● Improve on theoretical foundations required to solve the implementation</li> </ul> <p>Other:</p>	<p><u>Evaluator's Observation:</u></p> <p>Marks Secured: _____ out of _____</p> <p>Full Name of the Evaluator:</p> <p>Signature of the Evaluator      Date of Evaluation:</p>
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**PRACTICAL-11: Deblurring Images Based on Wiener Filtering**  
**Using OpenCV and Python**

Date of the Session: \_\_\_\_/\_\_\_\_/\_\_\_\_

Time of the Session: \_\_\_\_ to \_\_\_\_

**PRE-LAB TASK:**

1. What is a degradation image model?

2. How to restore a blurred image?



3. How do we apply deblurring using the Wiener filter?
4. What are the applications of Wiener filtering?

**IN-LAB TASK:**

1. Choose any blurred image and perform deblurring and image restoration by applying the Wiener filtering using opencv and python.
2. Apply deblurring using the Lucy-Richardson technique in opencv and python.



**POST-LAB TASK:**

1. Plot the histogram of the original and the deblurred image using each of the two techniques.
2. Analyze and discuss the differences between the histogram plots obtained in POST-LAB TASK-1.

<p><b><u>LAB-11: Comment of the Evaluator (Tick appropriate else write below)</u></b></p> <ul style="list-style-type: none"> <li>● Coding standard is poor. Considerable improvement on coding quality needed</li> <li>● Coding standard is good. Improve on finer aspects of coding.</li> <li>● Work shows gross negligence. Pay more attention to improve overall work quality</li> <li>● Improve on theoretical foundations required to solve the implementation</li> </ul> <p>Other:</p>	<p><u>Evaluator's Observation:</u></p> <p>Marks Secured: _____ out of _____</p> <p>Full Name of the Evaluator:</p> <p>Signature of the Evaluator      Date of Evaluation:</p>
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**PRACTICAL-12: Face Recognition using OpenCV and Python**

Date of the Session: \_\_\_\_/\_\_\_\_/\_\_\_\_

Time of the Session: \_\_\_\_ to \_\_\_\_

**PRE-LAB TASK:**

1. How does OpenCV face recognition work ?

3. Define Detect Multiscale Module.



### **IN-LAB TASK:**

A company wants you to build a new application which is based on openCV that recognizes the face and eyes performing face detection, as per the instructions provided below.

- 1) Using `harcascade_frontal_face.xml` file for detecting the face
- 2) Detecting the face by indicating a square shape of green color.
- 3) Using `harcascade_frontal_eye.xml` for detecting the eyes.
- 4) Detecting the eyes by indicating a square shape of blue color.







**POST LAB:**

1) Enumerate and analyze the applications of face recognition and explain the implementation of one of them.

<p><b><u>LAB-12: Comment of the Evaluator (Tick appropriate else write below)</u></b></p> <ul style="list-style-type: none"> <li>● Coding standard is poor. Considerable improvement on coding quality needed</li> <li>● Coding standard is good. Improve on finer aspects of coding.</li> <li>● Work shows gross negligence. Pay more attention to improve overall work quality</li> <li>● Improve on theoretical foundations required to solve the implementation</li> </ul> <p>Other:</p>	<p><u>Evaluator's Observation:</u></p> <p>Marks Secured: _____ out of _____</p> <p>Full Name of the Evaluator:</p> <p>Signature of the Evaluator      Date of Evaluation:</p>

# THE END