**SCHEME**

**for**

# Minor Degree / Specialization


**Department of Computer Engineering**

FACULTY OF INFORMATICS & COMPUTING

## J. C. Bose University of Science & Technology, YMCA

## Faridabad, Haryana

# J. C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA

## VISION

J. C. Bose University of Science and Technology, YMCA, Faridabad aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building.

## MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creative activities.
- To provide an enviable research environment and state-of-the art technological exposure to its scholars.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities.

# DEPARTMENT OF COMPUTER ENGINEERING

## VISION

The department aims to make a place at both national and international level by producing high quality ethically rich computer engineers conversant with the state-of-the-art technology with the ability to adapt the upcoming technologies to cater to the ever changing industrial demands and societal needs. It endeavours to establish itself as a centre of excellence by contributing to research areas having IT impact on the people's life and nation's growth.

## MISSION

- To provide the future leaders in the area of computer engineering and information technology through the development of human intellectual potential to its fullest extent.
- To enable the students to acquire globally competence through problem solving skills and exposure to latest developments in IT related technologies.
- To educate the students about their professional and ethical responsibilities.
- To ensure continuous interaction with the industry and academia through collaborative research projects.

# ABOUT THE SCHEME

With a view to enhance the employability skills and impart deep knowledge in emerging areas, usually not being covered in Undergraduate Degree framework,concept of 'Minor Degree / Specialization' in emerging areas is being introduced from academic session 2022-23. Proposed Minor Degree / Specialization will require the earning of 18 to 20 credits.This scheme shall be an addition to the regular undergraduate program implying that its passing/failure shall not affect the result of regular undergraduate program being pursued by the student. Upon successful completion of the course, Minor / Specialization Degree shall be awarded to the candidate.

The Computer Engineering Department of the University has introduced the curriculum for following Minor / Specialization:

1. Computer Vision
2. Blockchain

These emerging areas will help students in capturing the plethora of employment opportunities available in these domains.

NOTE

1. The scheme will be applicable from Academic Session 2022-23onwards.
2. This will be a three-semester program which will start in the 5$^{th}$sem of the B.Tech. program.

# Computer Vision

# Minor Specialization – Computer Vision

| SNO | Code No. | Course Title | Hours per week | | | Credits | Semester | Marks for Sessional | Marks for End Term Examination | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | | | | | |
| **1** | MD-CV-501 | Image Processing | 3 | 0 | 0 | 3 | **5** | **25** | 75 | 100 |
| **2** | MD-CV-502 | Computer Vision using Python | 4 | 0 | 0 | 4 | **6** | **25** | 75 | 100 |
| **3** | MD-CV-503 | Python Lab | 0 | 0 | 2 | 2 | **6** | **15** | 35 | 50 |
| **4** | MD-CV-504 | Minor Project | 0 | 0 | 2 | 2 | **6** | **25** | 25 | 50 |
| **5** | MD-CV-505 | Image and Video Analytics using Machine Learning | 4 | 0 | 0 | 4 | **7** | **25** | 75 | 100 |
| **6** | MD-CV-506 | Major Project | 0 | 0 | 4 | 4 | **7** | **50** | 50 | 100 |

# CODE: MD-CV-501

# SUBJECT NAME: Image Processing

# CREDITS: 3

**B.TECH. 5th SEMESTER** **SESSIONAL: 25**

**L TP** **THEORY EXAM: 75**

**3 0 0** **TOTAL: 100**

**Course Objectives:**

The students will be able to

1. Understand the fundamentals of digital image processing techniques as well as imagetransform and their properties.
2. Get knowledge about various techniques of Image Enhancements.
3. Learn about color image processing techniques.
4. Study about various techniques of Image Compression and segmentation.

**Module 1**

**Image Processing Fundamentals:** Components of an Image Processing System, Sampling and Quantization, Representing Digital Images , Some Basic Relationships Between Pixels- Neighbours and Connectivity of pixels in image, Examples of fields that uses digital image processing

**Module 2**

**Image Enhancement in The Spatial Domain**: Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods.

**Module 3**

**Color Image Processing:**Color models–RGB, YUV, HSI; Color transformations–formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening.

**Module 4**

**Image Segmentation**: Introduction, Detection of isolated points, line detection, Edge detection, Edge linking, Region based segmentation- Region growing, split and merge technique, local processing, regional processing, Hough transform, Segmentation using Threshold.

**Module 5**

**Image Compression**: Introduction, coding Redundancy , Inter-pixel redundancy, image compression model, Lossy and Lossless compression, Huffman Coding, Arithmetic Coding, LZW coding, Transform Coding, Sub-image size selection, blocking, DCT implementation using FFT, Run length coding.

**Reference Books:**


1. Anil K Jain, "Fundamentals of Digital Image Processing", PHI Edition 1997.

2. Keenneth R Castleman, “Digital Image Processing", Pearson

3. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing",

4. Pearson Chanda&Majumder, "Digital Image Processing &Analysis", PHI


**Course Outcomes**

On successful completion of this course, the students should be able to:

1. Understand the concepts of digital Image processing fundamentals and image transforms and their properties.
2. Analyze and mathematically represent various types of images
3. Process the images for the enhancement of certain properties or for optimized use of the resources.
4. Develop algorithms for image compression and coding.

# CODE: MD-CV-502

# SUBJECT NAME: Computer Vision Using Python

# CREDITS: 4

**B.TECH. 6th SEMESTER** **SESSIONAL: 25**

**L TP** **THEORY EXAM: 75**

**40 0** **TOTAL: 100**

**Course Objectives:**

**The student will be able to**

- Use OpenCV to work with image files.
- Perform image manipulation with OpenCV, including smoothing, blurring, thresholding, and morphological operations.
- Use Python and Deep Learning to build image classifiers.
- Use Python and OpenCV to draw shapes on images and videos.

**Module 1:**

Introduction , Overview and State-of-the-art, The Four Rs of Computer Vision, Geometry of Image Formation, Digital Image Formation and low level processing, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Restoration, Histogram Processing, Two View Geometry, Planar Scenes and Homography, Interest Point Detection.

**Module 2:**

Introduction, Data types and operators: Operators (unary, arithmetic, etc.), Data types, variables, expressions, and statements, Assignment statements ,Strings and string operations , Control Structures: loops and decision, Modularization and Classes: Standard modules ,Packages , Defining Classes ,Defining functions ,Functions and arguments, Introduction to Numpy, openCV, Pandas.

**Module 3:**

Features of Image, Read, write & show Image, Read, write & show Image using Webcam, Draw Geometric shapes, Mouse Event handling, Arithmetic operation on Image, Bitwise operations on Image.

**Module 4:**

Translation of Image, Rotation of Image, Scaling of Image, Image Wrapping, Blurring and Smoothening of Image, Sharpening of Image, Image Enhancement, Image Morphing, Image Cloning, Image Segmentation, Image Registration.

**Module 5:**

Simple Thresholding, Adaptive Thresholding, Erosion & Dilation, Edge Detection, Image Pyramids, Image Blending, Contours, Sorting of Contours, Matching of Contours, Motion: Optic Flow, Normalized Cross Correlation

**Text Books/ References:**

- Computer Vision: Algorithms and Applications by Richard Szeliski. Available for free online.
- Computer Vision: A Modern Approach (Second Edition) by David Forsyth and Jean Ponce. Available for free online.
- Elements of Statistical Learning by Trevor Hastie, Robert Tibshirani, and Jerome Friedman. Available for free online (Warning: Direct PDF link).
- Multiple View Geometry in Computer Vision (Second Edition) by Richard Hartley and Andrew Zisserman. Available for free online through the UM Library (Login required).

**Course Outcomes:**

**After completion of course, students should be able to:**

1. Be able to apply relatively simple methods to analyze images in practical settings.
2. Be prepared for a master level course on computer vision.
3. Perform image manipulation with OpenCV, including smoothing, blurring, thresholding, and morphological operations.

# CODE: MD-CV-503

# SUBJECT NAME: Python Lab

# CREDITS: 2

**B.TECH. 6th SEMESTER** **SESSIONAL: 15**

**L TP** **THEORY EXAM: 35**

**002** **TOTAL: 50**

**Lab Work:**

1. Python for IP and CV
    i. Python for image processing
    ii. Contrast Sketching
    iii. Linear Filtering
2. Skin Color Detection using Python
3. Wrapping and Estimations
4. Local Structures using Python
5. Image Stitching using SIFT

# CODE: MD-CV-504

# SUBJECT NAME: Minor Project

# CREDITS: 2

| | |
|---|---|
| **B.TECH. 6th SEMESTER** | **SESSIONAL: 25** |
| **L TP** | **THEORY EXAM: 25** |
| **002** | **TOTAL: 50** |

Minor project to implement Image Processing concepts in Python.

# CODE: MD-CV-505

# SUBJECT NAME: Image and Video Analytics using Machine Learning

# CREDITS: 4

**B.TECH. 7th SEMESTER** | **SESSIONAL: 25**

**L TP** | **THEORY EXAM: 75**

**40 0** | **TOTAL: 100**

**Course Objectives:**

- Introduce the concept of learning patterns from data and develop a strong theoretical foundation for understanding state of the art Machine Learning algorithms.
- To understand the algorithms available for performing analysis on image and video data and address the challenges
- To address the research issues towards developing algorithms that can perform high-level visual recognition tasks on real-world images and videos.

**Module 1:**

**Linear Regression:** Regression,Model representation for single variable, Single variable Cost Function, Gradient Decent for Linear Regression, Gradient Decent in practice, PCA and its advantages.

**Module 2:**

**Logistic Regression:** Classification, Decision tree, Random Forest, Essemble Techniques, Decision Boundary, Cost function, Advanced Optimization, Overfitting and Underfitting.

**Module 3:**

Introduction to pattern recognition and its applications, prominent algorithms and methods of pattern recognition, statistical & neural approaches: minimum error rate classification, classifiers, discriminant functions, decision surfaces, normal density, discrete features, Maximum-likelihood estimation: gaussian case, Maximum posteriori estimation, Bayesian estimation, Linear discriminants: separability, Perceptron, Support Vector Machines.

**Module 4:** Introduction to video analytics, Video processing – video formation, video sampling, motion estimation, motion-compensated (MC) filtering, video processing: frame-rate conversion, video coding, video compression, frame-based compression (MPEG), computer vision challenges: spatial domain processing, frequency domain processing, background modelling.

**Module 5:** Object detection and recognition, face detection and recognition, tracking- object tracking using active contours, tracking and video analysis, tracking and motion understanding, Hierarchical block matching, overlapped block motion & compensation-recursive motion estimation, mesh based method, optical flow method, motion segmentation, thresholding for change detection, estimation of model parameters.

**Text Books/References:**


1. R. C. Gonzalez, R. E. Woods, Digital Image Processing (3 ed.), Pearson Education, 2007. ISBN 978-0131687288.
2. K. Jain, Fundamentals of Digital Image Processing (1 ed.), Pearson Education India, 2015. ISBN 978-9332551916.
3. Murat Tekalp, Digital Video Processing (2 ed.), Prentice Hall, 2015. ISBN 978-0133991000.
4. Thierry Bouwmans, FatihPorikli, Benjamin Höferlin and Antoine Vacavant, Background Modeling and Foreground Detection for Video Surveillance: Traditional and Recent Approach (1 ed.), CRC Press, Taylor and Francis Group, 2014. ISBN 9781482205374.
5. Bishop, C. M., Pattern Recognition and Machine Learning (2 ed.), Springer, 2011. ISBN 978-0387310732.
6. Duda, R.O., Hart, P.E., and Stork, D.G., Pattern Classification (2 ed.), Wiley, 2007. ISBN-978-0471056690.
7. Saroj Kaushik, Artificial Intelligence, Cengage Learning, 1st Edition2011.
8. Anindita Das Bhattacharjee, "Practical Workbook Artificial Intelligence and Soft Computing for beginners, Shroff Publisher-X teamPublisher.
9. Yuxi (Hayden) Liu, "Python Machine Learning by Example", Packet Publishing Limited,2017.
10. Tom Mitchell, Machine Learning, McGraw Hill,2017.
11. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer,2011.
12. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e,2011.


**Course Outcomes:** After completion of course, students should be able to:

1. Design and implement machine learning solutions to classification, regression and clustering problems.
2. Evaluate and interpret the results of the different MLtechniques.
3. Design and implement various machine learning algorithms in a range of Real-world applications.
4. To understand the approaches for identifying and tracking objects and person with motion-based algorithms.
5. To understand the fundamentals of pattern recognition and its relevance to classical and modern problems and identify and formulate the pattern recognition problems.

**B.TECH. 7th SEMESTER**

# CODE: MD-CV-506

# SUBJECT NAME:

# Major Project

# CREDITS: 4

| | | | |
|---|---|---|---|
| | | | **SESSIONAL: 50** |
| **L** | **T** | **P** | **THEORY EXAM: 50** |
| **0** | **0** | **4** | **TOTAL: 100** |

Major project to implement Computer Vision