VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
B.E: Electronics & Communication Engineering / B.E: Electronics & Telecommunication Engineering
NEP, Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021 – 22)

VII Semester

Digital Image Processing			
Course Code	**21EC732**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Understand the fundamentals of digital image processing.
- Understand the image transform used in digital image processing.
- Understand the image enhancement techniques in spatial domain used in digital image processing.
- Understand the Color Image Processing and frequency domain enhancement techniques in digital image processing.
- Understand the image restoration techniques and methods used in digital image processing.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Show Video/animation films to explain the functioning of various image processing concepts.
2. Encourage cooperative (Group) Learning through puzzles, diagrams, coding etc., in the class.
3. Encourage students to ask questions and investigate their own ideas helps improve their problem-solving skills as well as gain a deeper understanding of academic concepts.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Students are encouraged to do coding based projects to gain knowledge in image processing.
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in multiple representations.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding
9. Arrange visits to nearby PSUs such as CAIR (DRDO), NAL, BEL, ISRO, etc., and small-scale software industries to give industry exposure.

Module-1

Digital Image Fundamentals: What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels.
[Text 1: Chapter 1, Chapter 2: Sections 2.1 to 2.5]

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Videos on Image processing applications Self-study topics: Arithmetic and Logical operations Practical topics: Problems on Basic Relationships Between Pixels. **RBT Level:** L1, L2, L3

Module-2	
Image Transforms: Introduction, Two-Dimensional Orthogonal and Unitary Transforms, Properties of Unitary Transforms, Two-Dimensional DFT, cosine Transform, Haar Transform. Text 2: Chapter 5: Sections 5.1 to 5.3, 5.5, 5.6, 5.9]	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos of various transformation techniques and related applications. Self-study topics: Sine transforms, Hadamard transforms, KL transform, Slant transform. Practical topics: Problems on DFT and DCT **RBT Level:** L1, L2, L3
Module-3	
Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters [Text: Chapter 3: Sections 3.2 to 3.6]	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos and animations of Intensity Transformation Functions, Histogram Processing, Spatial domain filters. Self-study topics: Point, line and edge detection. Practical topics: Problems on Intensity Transformation Functions, Histogram, Spatial domain filters **RBT Level:** L1, L2, L3
Module-4	
Frequency Domain: Basics of Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters. **Color Image Processing:** Color Fundamentals, Color Models, Pseudo-color Image Processing. [Text 1: Chapter 4: Sections 4.7 to 4.9 and Chapter 6: Sections 6.1 to 6.3]	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos on frequency domain filtering, Color image processing. Self-study topics: Basic concept of segmentation. Practical topics: Problems on Pseudo-color Image Processing **RBT Level:** L1, L2, L3
Module-5	
Restoration: A model of the Image Degradation/Restoration Process, Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering. [Text 1: Chapter 5: Sections 5.1, to 5.4.3, 5.7, 5.8]	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos on Noise models, filters and its applications. Self-study topics: Linear position invariant degradation, Estimation of degradation function. **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Understand image formation and the role of human visual system plays in perception of gray and color image data.
2. Compute various transforms on digital images.
3. Conduct independent study and analysis of Image Enhancement techniques.
4. Apply image processing techniques in frequency (Fourier) domain.
5. Design image restoration techniques.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Digital Image Processing- Rafael C Gonzalez and Richard E Woods, PHI, 3rd Edition 2010.
2. Fundamentals of Digital Image Processing- A K Jain, PHI Learning Private Limited 2014.

Reference Book:

Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill, 2014.

Web links and Video Lectures (e-Resources)

- Image databases, https://imageprocessingplace.com/root_files_V3/image_databases.htm
- Student support materials, https://imageprocessingplace.com/root_files_V3/students/students.htm
- NPTEL Course, Introduction to Digital Image Processing, https://nptel.ac.in/courses/117105079
- Computer Vision and Image Processing, https://nptel.ac.in/courses/108103174
- Image Processing and Computer Vision – Matlab and Simulink,
- https://in.mathworks.com/solutions/image-video-processing.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Verilog /VHDL coding for Image manipulation.
- Simulink models for Image processing.