Course Code: CSE3022	**Course Name:** **Digital Image Processing**	
Credits: 3 (2-0-2)	**Contact Hours:** 2 hour Theory & 2 hours lab per week	
Batch: 2022, 5th Sem CSE **Academic Year:** 2024-25	**Semester Duration:** 5th Aug 2024 to 6th Dec	
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Aim of the course: The aim of this course is to help the students understand the fundamental concepts of digital image processing. The course involves hands-on learning in the form of projects and practical sessions. At the end of the course, the students will be able to understand how digital images are formed, acquired, processed and used for various applications

Course Overview and Context:

There is a high demand of professionals knowing image processing and related field of studies, in the industry. There are tons of interesting applications which require capturing, storing and processing digital images – e.g. automatic face recognition from images, medical image processing, automated robotic movements, surveillance, document processing etc. With the popularity of social media and consumer electronic devices like smart phone, millions of images are being captured and shared on a daily basis on the internet. This has opened up the horizon of developing smart applications involving images for a better quality of service.

In view of this, the Digital Image Processing course is designed to give the students an overview of what digital images are, and how they are captured and processed. The course contains hands-on sessions to be conducted using open-source tools. This will help the students to practice the theoretical concepts learned during lecture sessions. Upon successful completion of the course, the students should be able to write programs for capturing, manipulating, and processing digital images.

Course Outcomes (CO): At the end of the course the students should be able to do the following:
CO1: **Understand fundamental concepts and principles of digital image processing.**

CO2: **Apply and demonstrate different image pre-processing and enhancement techniques in the spatial and frequency domains.**

CO3: **Analyze various state of art algorithms to process images for various applications.**

CO4: **Design framework to solve real-life and societal problems using appropriate methods, interpreting results, and reporting**

Topics of the course:

Topics	Number of sessions	Course Outcomes
Visual Perception • Image Sensing and Acquisition • Image Sampling and Quantization • Representing Digital Images • Spatial and Intensity Resolution	2	CO1
Gray-level transformations and processing in the spatial domain, Enhancement using arithmetic/logic operations, Image derivatives, filtering- smoothing, sharpening, convolution and correlation. Histogram processing – stretching, equalization, and matching. Image interpolation.	3	CO1, CO2, CO3
Fourier transformation and processing in the frequency domain – DFT, FFT, Inverse Fourier transformation, Filtering: smoothing and sharpening in the frequency domain, convolution.	3	CO1, CO2, CO3
Wavelet Transform and Multi-resolution Processing: Introduction to Wavelet Transform, Continuous and Discrete Wavelet Transform, Wavelet-based image processing techniques, Multi-resolution analysis, Applications of Wavelet Transform in image compression and denoising	3	CO1, CO2, CO3
Noise models, restoration in the spatial domain, periodic noise reduction using frequency domain filtering, and Inverse filtering.	4	CO1
Color models and transformations, Smoothing and sharpening, and segmentation.	2	CO1, CO2
Dilation • Erosion • Opening • Closing • Boundary extraction • Thinning.	5	CO1
Image compression fundamentals • Lossless compressions and Lossy compression Techniques.	5	CO1, CO3, CO4
Detection of discontinuities, Edge linking, and boundary detection, Thresholding, Region-based segmentation, Segmentation using morphology.	5	CO1, CO3
Introduction to Image Representation and Description: - Chain code, Polynomial approximation, Signatures, Skeletons; Regional description – Texture -- gray-level-cooccurrence matrix.	4	CO1

CO/PO Mapping:

CO/PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1										1	3	2		
CO2	2	3		1										2		
CO3		3	2													
CO4						2		1	2	2				3	2	

Learning Resources:

Textbook:

1. Rafael C. Gonzalez, Richard E. Woods; Digital Image Processing; 3rd Ed., Pearson, ISBN: 978-0131687288

Refernce Books:

1. Anil K. Jain; Fundamentals of Digital Image Processing, 1st Ed., Prentice Hall, ISBN: 978-0133361650
2. William K. Pratt; Digital Image Processing; 4th Ed., Wiley India Private Limited, ISBN: 978-1482216691
3. Kenneth R. Castleman; Digital Image Processing; 1st Ed., Pearson Education, ISBN: 978-0132114677
4. Mark Nixon, Alberto S. Aguado; Feature Extraction & Image Processing, 2nd Ed., Academic Press Inc. ISBN: 978-0-12372-538-7
5. Digital Image Processing – 2nd edition, By S. Sridhar, Publisher: OXFORD University Press

Video lectures/ MOOC: https://www.coursera.org/learn/digital

Reference Links:
https://www.coursera.org/learn/digital

Experiential Learning Component:
In this course, students are required to provide the use cases of Image processing techniques to implement something new as part of a project that has not been done before in the literature, either by proposing novel improvements to an existing method, applying existing methods to new types of data, or proposing a new task or dataset. The students are also expected to implement and show the results of the proposed solution or attempt to reimplement and improve on a research paper on a topic of their choice. There is approx. 60-70% is experiential learning.

Assessment Pattern: The final grade will be based on the marks/ grades obtained in the mid-semester and end-semester evaluation and other assessments defined in the assessment table. The relative grading method described in the university's academic regulations will be followed to grade the students. The student must secure a minimum of 40% of marks after completing all the assessments in the following table to become eligible for grading.

Assessment Pattern: The final grade will be determined by the marks or grades earned during the project's phase-wise evaluations and the end-term assessment. Grading will be conducted using the relative grading

method outlined in the university's academic regulations. To be eligible for grading, students must achieve a minimum of 40% of the total marks upon completing all assessments listed in the table below:

Evaluation Component	Weightage (%)	Evaluation Schedule	Rubrics
Quiz (1)	20%	Will be held after approx. after 6 weeks of the commencement of the course.	There will only be one quiz. There will not be any recourse/repeat
Project Phase Evaluation 1	10%	1st week of September	**Project Proposal & Synopsis (5**%): Clarity and articulation of the project objectives, Relevance and originality of the problem statement. Feasibility and scope of the proposed project. **Understanding of Problem Statement (5%):** Identification of key challenges and potential solutions. Alignment of the problem statement with project objectives.
Project Phase Evaluation 2	30%	2nd -3rd week of October	**Project Proposal Refinement (5%):** Improvement and refinement of the initial project proposal. Incorporation of feedback from the first evaluation phase. **Literature Survey (10%):** Depth and relevance of the literature review. Critical analysis of existing work and identification of gaps. **Methodology (10%):** Appropriateness and rigor of the proposed methodology. Clarity in the explanation of methods, tools, and techniques. Justification of chosen methods in relation to the problem. **Preliminary Final Results (5%):** Presentation of initial results or findings. Relevance and accuracy of the preliminary data. Ability to analyze and interpret the results within the project's scope.
End Term Evaluation (Project Phase Evaluation -2)	40%	As per academic calendar/Date-sheet	**Final Project Presentation (10%): Clarity**, coherence, and professionalism of the presentation. Effective communication of project objectives, methodology, and results. Response to questions and ability to defend the project work.

			Project Report (15%): Structure, completeness, and quality of the written report. Thoroughness in documenting methodology, results, and analysis. Clarity in writing, proper formatting, and adherence to guidelines. **Final Results & Analysis (10%):** Accuracy and significance of the final results. Depth of analysis and interpretation of data. Alignment of results with project objectives and problem statement. **Innovation & Impact (5%):** Originality and innovation in the approach and solution. Potential impact and contribution of the project to the field. Consideration of real-world applicability and future work.

- All evaluations will be based on the work presented by the students as well as the questions asked, or the problems given to code.
- Cases of AI-generated code or plagiarism will be taken seriously and reported according to the university's policy on Unfair Means (UFM). It is essential that all work is original and adheres to academic integrity.
- There is a mandatory requirement to upload the project to a public repository on GitHub.

Student Responsibilities:

- Attend lectures and do the work Lab Assignments as per instructions.
- Participate in the discussions/assignments held during classes.
- Check announcements on the LMS and emails regularly.
- Submit the assigned task on time.
- Regularly check marks on the LMS to ensure they are up to date.
- Participate in class and take necessary actions to grasp the material. Asking questions is encouraged.
- Communicate any concerns by speaking directly with the instructor.

Attendance Policy: Students are expected to attend classes regularly. Failure to follow the classes regularly and adhere to the expected attendance percentage will result in losing quiz/lab marks and a reduction of the grade as per the University's grading policy.

Recourse Examination Policy: In case a student fails the course, a one-time recourse is permitted as per the academic regulations of the University. Recourse is allowed only for the End Semester examination.

Make-up policy: No make-up exam will be conducted for unexcused absences. The faculty needs to be informed in advance in case the student is not going to appear for any evaluation component, and it is at the discretion of the faculty to sanction makeup for an evaluation component.

Behavior Expectations: No mobile phones and other distractive gadgets are permitted in the class.

Academic Dishonesty/Cheating/Plagiarism: Plagiarism and dishonesty in any form in any evaluation component will lead to appropriate disciplinary action.