# Course Outline

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| **Course title: Digital Image Processing and Application** | **Instructor name: Test 2** |
| **Credit units: 3** | **Total hours: 54** |

## Course Description:

Digital Image Processing and Application is a course designed for 4th Year Electrical Engineering students who are interested in learning about the fundamentals of digital image processing and its applications. The course will cover the basic concepts of image processing, including image acquisition, image enhancement, image restoration, image segmentation, and image compression.   
  
The course will also focus on the practical applications of digital image processing in various fields, such as medical imaging, remote sensing, and computer vision. Students will learn how to use various software tools and programming languages, such as MATLAB, Python, and OpenCV, to implement digital image processing algorithms and analyze the results.   
  
Throughout the course, students will work on several projects that involve real-world applications of digital image processing. These projects will help students develop their problem-solving skills and gain hands-on experience in applying digital image processing techniques to solve real-world problems.   
  
By the end of the course, students will have a solid understanding of the principles of digital image processing and its applications. They will be able to apply their knowledge to solve complex problems in various fields and will be well-prepared for careers in industries such as medical imaging, robotics, and computer vision.

## Course Learning Outcomes (CLOs)

* Understand the fundamental concepts and techniques of digital image processing, including image acquisition, enhancement, restoration, segmentation, and compression.
* Apply digital image processing techniques to solve problems in various applications such as medical imaging, remote sensing, and computer vision.
* Gain proficiency in using software tools and programming languages, including MATLAB, Python, and OpenCV, for implementing digital image processing algorithms.
* Develop problem-solving skills and hands-on experience through project-based learning on real-world digital image processing applications.
* Critically analyze and evaluate digital image processing techniques and their effectiveness in solving complex engineering problems.

## Topics / Modules and Intended Learning Outcomes

1. Introduction to Digital Image Processing

* Explain the basic concepts and principles of digital image processing.
* Identify the steps involved in the digital image processing pipeline, from acquisition to output.

1. Image Enhancement Techniques

* Apply various image enhancement techniques to improve the visual quality of images.
* Evaluate the effectiveness of different enhancement methods on various types of images.

1. Image Restoration and Reconstruction

* Understand the theory and algorithms behind image restoration and reconstruction.
* Implement algorithms for restoring images degraded by noise, blur, and other factors.

1. Image Segmentation Techniques

* Describe the role of image segmentation in digital image processing and its applications.
* Implement various segmentation techniques and evaluate their performance on different images.

1. Image Compression and Storage

* Explain the principles of image compression and the need for efficient image storage.
* Apply different image compression techniques and assess their impact on image quality and compression ratio.

## Weekly Activities

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| **Week No.** | **Topic** | **Activity Description** | **Expected Output** | **Assessment Tools** |
| Week 1 | **Introduction to Digital Image Processing** | Lecture on the history and basics of digital image processing. Introduction to the course structure and tools. | Understanding of digital image processing basics and setup of necessary software tools. | Quiz and software setup verification |
| Week 2-3 | **Image Enhancement Techniques** | Lectures on image enhancement techniques followed by lab sessions applying these techniques using MATLAB. | Enhanced images using different techniques and a lab report documenting the processes and outcomes. | Lab report and enhanced images |
| Week 4-5 | **Image Restoration and Reconstruction** | Understanding image degradation models and lectures on restoration techniques. Lab sessions on implementing restoration algorithms. | Restored sample images and a comprehensive lab report on the applied restoration techniques. | Lab report and presentation of restored images |
| Week 6-8 | **Image Segmentation Techniques** | Lectures on segmentation algorithms followed by projects that require students to segment images using Python and OpenCV. | A project report detailing the segmentation process, challenges, and outcomes. Segmented images. | Project report and segmented images |
| Week 9-10 | **Image Compression and Storage** | Lectures on the theory of image compression followed by practical sessions on implementing compression algorithms. | Compressed images using various algorithms and a lab report comparing the compression ratios and image quality. | Lab report and compressed images |
| Week 11-14 | **Project Work** | Students will work in groups on a project that involves applying learned digital image processing techniques to a real-world problem. | A project report and presentation showcasing the problem, applied techniques, and results. | Project report, presentation, and peer review |
| Week 15-17 | **Advanced Topics and Current Trends in Digital Image Processing** | Lectures on advanced topics and current trends in digital image processing, including deep learning applications. | Group presentations on selected advanced topics, demonstrating understanding and research. | Presentation and research paper |
| Week 18 | **Course Wrap-up and Review** | Review of course content, discussion on course projects, and feedback session. | Students will have a clear understanding of their performance and knowledge gained throughout the course. | Feedback forms and final exam |

## References

*Gonzalez, R. C., & Woods, R. E. (2018). Digital Image Processing (4th ed.). Pearson.*  
Link:

*Szeliski, R. (2010). Computer Vision: Algorithms and Applications. Springer.*  
Link:

*Andrews, H. C., & Hunt, B. R. (1977). Digital Image Restoration. Prentice-Hall.*  
Link:

*Shapiro, L. G., & Stockman, G. C. (2001). Computer Vision. Prentice Hall.*  
Link:

*Wallace, G. K. (1992). The JPEG still picture compression standard. IEEE Transactions on Consumer Electronics, 38(1), xviii-xxxiv.*  
Link: