# Course Outline

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| **Course title: Digital Image Processing and Application** | **Instructor name: Test** |
| **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 application areas such as medical imaging, remote sensing, and computer vision.
* Develop proficiency in using software tools and programming languages like MATLAB, Python, and OpenCV for implementing digital image processing algorithms.
* Analyze and interpret the results of digital image processing algorithms to make informed decisions in real-world applications.
* Execute projects that demonstrate the ability to apply digital image processing techniques to complex problems in industry-relevant scenarios.

## Topics / Modules and Intended Learning Outcomes

1. Introduction to Digital Image Processing

* Explain the fundamental principles of digital image processing and its importance in various applications.
* Describe the steps involved in the digital image processing pipeline, from acquisition to output.

1. Image Enhancement Techniques

* Implement various image enhancement techniques in MATLAB or Python to improve the visual quality of images.
* Evaluate the effectiveness of different enhancement methods on various types of images.

1. Image Restoration

* Understand the theory and algorithms behind image restoration and their applications in removing noise and distortions.
* Apply image restoration techniques using OpenCV and analyze their impact on image quality.

1. Image Segmentation

* Apply various image segmentation techniques to partition an image into its constituent parts or objects.
* Evaluate the performance of segmentation algorithms in the context of specific applications such as medical imaging or remote sensing.

1. Image Compression

* Understand the principles and algorithms of image compression and the trade-offs between compression ratio and image quality.
* Implement image compression algorithms and assess their effectiveness in reducing storage and bandwidth requirements.

## 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 fundamentals of digital image processing. Introduction to the course structure and objectives. | Students will have an understanding of the course scope and the importance of digital image processing. | Class participation and discussion |
| Week 2 | **Introduction to Digital Image Processing** | Interactive session on image acquisition and the digital image processing pipeline using practical examples. | Students will be able to describe the steps involved in digital image processing from acquisition to output. | Quiz |
| Week 3-4 | **Image Enhancement Techniques** | Hands-on lab sessions on implementing image enhancement techniques using MATLAB or Python. Students will work on enhancing the visual quality of provided images. | Implementation of various image enhancement techniques and a report on the effectiveness of each method. | Lab reports and code submissions |
| Week 5-6 | **Image Restoration** | Lecture and lab sessions on image restoration algorithms. Students will apply these techniques to remove noise and distortions from images using OpenCV. | Application of image restoration techniques and analysis of their impact on image quality. | Lab reports and presentations |
| Week 7-8 | **Image Segmentation** | Group project on image segmentation. Students will use segmentation techniques to partition an image into its constituent parts or objects for a given application scenario. | A project report and presentation on the segmentation technique used and its performance evaluation. | Project report and peer evaluation |
| Week 9-10 | **Image Compression** | Lectures and discussions on image compression principles and algorithms. Students will implement a compression algorithm and assess its effectiveness. | Implementation of an image compression algorithm and a report on the trade-offs between compression ratio and image quality. | Written report and code review |
| Week 11-14 | **Project Work** | Students will work in groups on a comprehensive project that involves applying digital image processing techniques to a real-world problem. This will include proposal writing, implementation, and final presentation. | A complete project that demonstrates the application of digital image processing techniques to solve a real-world problem. | Proposal, project report, and final presentation |
| Week 15-17 | **Review and Exam Preparation** | Review sessions covering all topics discussed throughout the course. Preparation for the final exam through problem-solving and Q&A sessions. | Students will consolidate their knowledge and prepare for the final exam. | Study guides and practice exams |
| Week 18 | **Final Exam** | Comprehensive final exam covering all course learning outcomes and topics. | Students will demonstrate their understanding of digital image processing principles and applications. | 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. (1991). The JPEG still picture compression standard. IEEE Transactions on Consumer Electronics, 38(1), xviii-xxxiv.*  
Link: