**Course Material link:** <https://drive.google.com/drive/folders/1LP1Mm0IPgaZ-yJ-Rshq5UlOqo5v3n__d?usp=sharing>

**CS-702 Image Compression and Rendering**

**Credit Hours 3 (3-0)**

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| **Program:** PhD | | **Semester:** I / II |
| **Pre Requisite:** None | | **Follow Up:** None |
| **Course Description**  Over the last few decades, many good image compression schemes have been developed. The performance of these schemes varies from low to high compression ratios with low to high levels of degradation of the decompressed images.  This course provides students with a solid understanding of the fundamentals and the principles of various digital still-image compression and rendering schemes. | | |
| **Course Objectives**  To be able to handle, efficiently, the huge amount of data associated with images, compression schemes are needed. Image compression is a process intended to yield a compact representation of an image, hence, reducing the image storage/transmission requirements. | | |
| **Learning Outcomes**  Students will be equipped with the fundamental knowledge that will help them understand various compression techniques in such a way as to optimize their use for a particular application. | | |
| **Textbooks**  None | | |
| **Reference Books / Material**   * Digital Image Processing by Gonzalez and Woods. * Computer Vision: The Modern Approach by Forsyth and Ponce. * The Computer Image by Watt and Policarpo. * 3D Computer Graphics by Watt. * Fundamentals of Computer Graphics by Peter Shirley. * Realistic Image Synthesis using Photon Mapping by Henrik Wann Jensen. * Realistic Ray Tracing by Peter Shirley and R. Keith Morley. * Multiple View Geometry in Computer Vision by Hartley and Zisserman. * Introduction to Data Compression by Khalid Sayood. | | |
| **Course Distribution** | Theory: 40%  Problem Analysis: 30%  Solution Design: 25%  Social and Ethical Issues: 5% | |
| **Marks Distribution** | Test 1: 10 Marks; Test 2: 10 Marks; Assignment: 05 Marks; Quiz: 05 Marks; Paper: 65 Marks; Attendance: 05 Marks | |
| **Technology Involved**  Internet | | |
| **Practiced Techniques**  Discussions, Presentations, Viva Voce | | |

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| **Week** | **Topic** |
| 1 | Introduction, size, quality of the image, storage requirements, transmission rate, image compression goals. |
| 2 | Image compression, different approaches, lossless compression, lossy compression, trade-off image compression vs. compression ratio, information vs. data. Data redundancy, compression ratio, relative data redundancy, types of data redundancy. |
| 3 | Coding redundancy, code, code word, code word length, interpixel redundancy, psychovisual redundancy, information modelling, information content. |
| 4 | Image compression model, lossless compression, repetitive sequence encoding, statistical encoding, lossless predictive encoding, bitplane encoding, codeword encoding. |
| 5 | Run length encoding, dictionary-based encoding, LZW encoding, decoding LZW, predictive encoding. |
| 6 | Lossless predictive encoding, tree-based encoding, huffman coding, combining huffman with run length encoding, lossy compression, block truncation coding, lossy predictive coding, transform coding, statistical sub band coding, fractal coding, vector quatization. |
| 7 | Differential pulse code modulation. |
| 8 | Jpeg compression, DCT, entropy encoding, JPEG for color images. |
| 9 | 3D computer graphics, 3D modeling, 3D rendering, modeming considerations, polygon models, image-based rendering. |
| 10 | Pixel-oriented rendering, polygon oriented rendering, image-based lighting, light rays, ray tracing, forward ray tracing, backward ray tracing, ray casting, ray casting algorithm. |
| 11 | Ray tracing algorithm, adding shadows, self shadowing, shadowing rays, reflection rays, transmission rays, raycasting vs. raytracing. |
| 12 | Soft shadows, hard shadows, radiosity, lighting fundamentals, 3D with and without lighting, lighting fundamentals, specular, diffuse and ambient lighting. |
| 13 | Polygon rendering, scan-line rendering, shading techniques, flat shading, gouraud shading, flat vs. gouraud shading. |
| 14 | Phong shading, global illumination. |
| 15 | Non-photorealistic rendering. |
| 16 | Principles, algorithms and coding schemes for static and moving images. |