B31SE Image Processing

COURSE DETAILS
Course Code: B31SE
Full Course Title: Image Processing
SCQF Level: 11
SCAF Credits: 15
Available as Elective: No

DELIVERY LEVEL
Undergraduate: Yes  Postgraduate Taught: Yes  Postgraduate Research: Yes

COURSE AIMS
- To provide a critical understanding of the principal theories and concepts of image analysis, modelling, enhancement and coding.
- To apply these theories and concepts to a range of digital images and video sequence.
- To provide a critical awareness of current issues in image processing.
- To provide the ability to analyse problems and develop applications in image processing.

LEARNING OUTCOMES – SUBJECT MASTERY
- Critical understanding of an extensive range of image processing problems & potential solutions.
- Practical knowledge of limitations of techniques to accompany detailed theoretical knowledge.
- Skill in the use of specialist image processing tools in the implementation of techniques.
- Knowledge of current research in imaging and image processing.

LEARNING OUTCOMES – PERSONAL ABILITIES
- Ability to analyse and develop mathematical descriptions of image transformations.
- Ability to critically review, evaluate and implement a range of techniques in image processing.

SYLLABUS
Core topics
- An introduction to Image Processing: Image representation, continuous and discrete, light and colour.
- Single Pixel Processing in the Spatial Domain: gray level transformations, histogram processing: equalisation, modification and matching.
- Image Transformations and the Frequency Domain: 2D analogue and digital Fourier.
transforms, convolution and correlation
- Image Filtering: smoothing and enhancement, simple linear filtering in the frequency domain, gradient/edge and corner detection, image restoration and Wiener filtering
- Image Formats and Compression: transmission and storage of images, image and video compression

Advanced topics: two selected from

- Texture analysis (statistical, fractals, Markov random fields and co-occurrence matrices)
- Segmentation: Nearest-neighbour segmentation and grouping; global thresholding and Hough transformation, clustering techniques
- Image classification: Supervised and unsupervised, naive classifiers (e.g., boxcar), minimum distance means, maximum likelihood
- Bayesian decision theory, k-means clustering
- The Haar transform, wavelet transforms in one and two dimensions, face detection using Haar wavelets
- Motion and video: the aperture and correspondence problems, frame differencing and motion detection, affine motion (Lukas-Kanade algorithm) and optical flow
- Geometric and wave theories of image formation, fundamental optical instruments (camera, microscope, telescope), polarisation imaging.