Subject Description Form

Subject Code	EIE546
Subject Title	Video Technology
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: Nil Recommended background knowledge: The student is expected to have background knowledge of Digital Signal Processing, and some programming skills (preferably C++) in his undergraduate studies. Mutual exclusions: Nil
Objectives	Objectives: This subject provides an in-depth discussion on a wide range of important and current techniques on digital videos.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. describe the basic principles of video technologies, such as video coding, video standards, video surveillance, 3D videos, video communications, video processing for IoT applications; b. describe the operational principles of one or two advanced topics of video technology and give evaluations; c. perform literature survey; give professional report, analysis, and/or carry out practical realization of video processing algorithms; d. appreciate and take up the related engineering work on video technology, and e. carry out initial research work on video technology.
Subject Synopsis/ Indicative Syllabus	**Keyword syllabus:** 1. Revision on entropy coding and digital video: Huffman coding and arithmetic coding, digitization, raster scanning, luminance & chrominance, composite video, RGB and YUV formats. 2. Basic image coding techniques applied to videos: transform coding, zigzag scan and run-level code. 3. Video coding: Block based video coding, Integer DCT coding, inter- & intra-frames, quantization and entropy coding; hybrid video coding scheme; motion estimation and compensation, frame types, fast motion estimation, and quality control. 4. Advanced video coding, sub-pixel motion estimation, mode decision, rate-distortion control, interpolation filters, multiple reference frames, variable block size, concepts of Prediction Unit, Coding Unit and Transform Unit; concepts of QoE (Quality of Experience). 5. Video coding standards: H.261-4, MPEG-1, 2 and 4, Scalable video coding, levels and profiles, advanced and future standards: HEVC (H.265).

6. Video streaming, architecture for video streaming, video streaming considerations for Internet of Things (IoT); statistical characteristics of signals, Constant Bit-Rate (CBR) and Variable Bit-Rate (VBR); video transmission systems, Quality of Service (QOS) requirement for video transmission; Error control and error concealment for digital video communication.

Due to the limitation in time, only 1 or 2 of the following topics will be covered:

7. A brief review on analogue TV. Introduction to digital TV; High definition TV (HDTV), standards and current development.
8. An Introduction to 3D Video coding, depth coding, 3DV/FTV (free video TV).
9. Video Transcoding, Homogeneous and heterogeneous transcoding, the drift problem, spatial and temporal domain transcoding.
10. Video Surveillance: Basic set-up for video surveillance, background extraction, moving object extraction and detection. IoT applications with video analytics, object identification/tracking by template matching, HoG (Histogram of Oriented Gradients), and colour Histogram.

Laboratory Exercises

1. Laboratory Exercise 1: Image and video Processing under Visual C++ environment
   The objectives of this laboratory include: (i) to display images and videos using a Library, (ii) to read and write images/videos using Visual C++ Console Application, and (iii) to modify images at any pixel location using Visual C++ Console Application.

2. Laboratory Exercise 2: MPEG-4(Part10)/H.264 Verification Model
   This exercise is to let the student familiar with the 'MPEG-4 part10 (H.264) Verification Module', such that the student can understand MPEG-4 Part 10 better, evaluate its structure and make use of the verification model to develop further algorithms for its realization. Topics of specific attention include multiple reference frame coding, quarter-pixel and variable block size motion estimation, etc

Teaching/Learning Methodology

The theories and applications of video technology will be discussed and explained in lectures. Lab sessions will be provided to strengthen students' understanding. Students will also be requested to write a report on a given topic.

Teaching/Learning Methodology	Intended Subject Learning Outcomes				
	a	b	c	d	e
Lectures	✓	✓		✓	✓
Tutorials	✓	✓		✓	✓
Self-learning/report	✓	✓	✓	✓	✓
Laboratory exercise	✓	✓	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		a	b	c	d	e
1. Continuous assessment	50%	✓	✓	✓	✓	✓
• Assignment	12%			✓		✓
• Tests	16%	✓	✓		✓	

	• Quizzes	10%	✓	✓		✓	
	• Laboratory Sessions	12%	✓	✓	✓	✓	✓
	2. Examination	50%	✓	✓		✓	✓
	Total	100%					

Student Study Effort Expected	**Class contact:**	
	▪ Lectures/Tutorial/Laboratory	39 Hrs.
	Other student study effort:	
	▪ Self study and Assignments	66 Hrs.
	Total student study effort Tutorials	105 Hrs.

Reading List and References

Indicative reading list and references:

1. A.M. Tekalp, *Digital Video Processing*, Prentice-Hall, 2015.
2. Madhuri A. Joshi, *Image and Video Compression: fundamentals, techniques and applications*, CRC Press, 2015.
3. I.E.G. Richardson, *H.264 and MPEG-4 Video Compression*, John Wiley & Sons, Ltd, 2003.
4. H. Sun, X. Chen and T. Chiang, *Digital Video Transcoding for Transmission and Storage*, CRC Press, 2005.
5. C.A. Poynton, *A Technical Introduction to Digital Video*, John Wiley & Sons, Inc., 1996.
6. F. Pereira and T. Ebrahimi, *The MPEG-4 Book*, Prentice Hall PTR, 2002.
7. A. Walsh and M. Bourges-Sevenier, *MPEG-4 Jump Start*, Prentice Hall PTR, 2002.
8. Selected Reading from recent issues of IEEE Transactions on Circuits and Systems for Video Technology and IEEE Transactions on Image Processing, between years 2008 to 2016.
9. H.246 JM and HEVC HM evaluation models, 2016.