Course:	An Introduction to Multimedia Systems - 8101710

Course type:		EE*						CE*			
		Com	E	P	B	Con	D	SW	HW	IT	Credit: 3
	Required	☐	☐	☐	☐	☐	☐	☐	☐	☒	
	Elective	☐	☐	☐	☐	☐	☐	☒	☒	☐	

Level:	Undergraduate ■ Graduate ☐
Co-requisite(s):	N/A
Prerequisite(s):	N/A
Prerequisite by topic:	Knowledge of Digital Signal Processing, and Probability
Textbook(s):	M. Ghanbari. Standard Codecs: Image Compression to Advanced Video Coding, 3rd ed., Institution of Engineering and Technology, 2011. Ralf Steinmetz, Klara Nahrstedt. Multimedia Systems, Springer, 2010.
Coordinator:	Mahmoud Reza Hashemi
Goals:	Multimedia has become an indispensable part of modern computer technology. Multimedia systems are playing an increasing role in most aspects of information technology, impacting the design of hardware, software, networks and applications. Multimedia is also one of the critical links in the ongoing unification of computing and communications. This course aims to give a practical introduction into multimedia systems, applications, and communication. We will address how to efficiently represent multimedia data, including video, image, and audio, and how to deliver them over a variety of networks. In the coding aspect, state-of-the-art compression technologies will be presented. Emphasis will be given to a number of standards, including H.26x, MPEG-x, JPEG, and JPEG2000. In the networking aspect, special considerations for sending multimedia over wireless, and IP networks, such as error resilience and quality of service, will be discussed. The H.32x series of standards for audiovisual communication systems in various network environments and SIP will be introduced. Emerging

	technologies in multimedia communications will be studied by the students as part of their course project.
Outcome:	Upon successful completion of the course, students will have a better understanding of multimedia systems, applications, and communication and their inherent requirements. This course will enable students to: 1- Describe major techniques for lossy and lossless compression of multimedia content 2- Explain entropy coding, variable length coding 3- Explain the concept of Rate-Distortion-Complexity 4- Describe the fundamentals of Transform coding and Predictive coding 5- Describe the challenges and solutions for video and audio synchronization 6- Describe major image, video, and audio compression techniques and standards 7- Explain multimedia networking considerations such as error, QoS, QoE, multicasting, and streaming. 8- Identify and explain the main concerns in software and hardware implementation of multimedia systems.
Topics:	This course covers topics such as: 1- Image fundamentals (color representation) 2- Principles of lossless coding (Entropy coding, Huffman coding, arithmetic coding, run length coding, dictionary based coding 3- Principles of lossy coding (Vector quantization, Rate-Distortion) 4- Principles of image compression (DCT, JPEG, DWT, JPEG2000) 5- Rate allocation 6- Video fundamentals 7- Principles of video compression (Transform coding, predictive coding, H.26x, MPEG-x) 8- Principles of Audio coding (MP3, AAC, AC-3) 9- MPEG Systems 10- Principles of multimedia conferencing (H.32x, SIP) 11- Principles of multimedia networking (Error detection, recovery, control, concealment, error resilience, QoS, QoE, multicast, streaming) 12- MEPG-7 and MPEG-21
Computer usage:	Students will use applications such as Matlab, and programming languages such as C or C++ for their assignments.
Assignments:	Students are expected to submit 6 to 8 assignments throughout the semester.
Projects:	Each student is required to complete a course project, which involves studying one of the emerging technologies in multimedia that have made it to the market. Each student should present the project to the class in two half hour sessions throughout the semester.

Grading:	Assignments:	15%
	Course project	15%
	Midterm exams:	38%
	Final exam:	32%
Further readings:	[1] Iain E. Richardson. The H.264 Advanced Video Compression Standard, 2nd ed., Wiley, 2010. [2] Other supporting documents in the form of standard drafts, and journal papers will be provided through the course website.	
Prepared by:	Mahmoud Reza Hashemi	
Date:	Last revision: December 12, 2017	

*EE: Electrical Engineering   CE: Computer Engineering   IT: Information Technology