Ahsanullah University of Science and Technology
Bangladesh

COURSE OUTLINE

Part A

1. Course No./Course Code: ***CSE 4227 (BNQF 061)***

2. Course Title: ***Digital Image Processing***

3. **Course Type (GEd/Core Course/Elective):** ***Elective Course***

4. Year/Level/Semester/Term: ***Year 4 Semester 2***

5. Academic Session: ***Spring 2022***

6. Course Teacher/Instructor: ***Prof. Dr. Kazi A Kalpoma***

7. Pre-requisite(s) (if any): ***CSE 4203 (Computer Graphics)***

8. Credit Value: ***3***

9. Credit Hours: ***3***

10. Total Marks: ***100***

11. Rationale of the Course: ***SDG 4 (Ensure Technical Level Education) and SDG 8 (Reduce Unemployment Rate).***

12. Faculty: Engineering

13. Department: Computer Science and Engineering (CSE)

14. Program: Bachelor of Science in Computer Science and Engineering (B.Sc. in CSE)

15: Course Objectives:

Digital image representation and acquisition; Survey of modern techniques for image analysis, processing and enhancement. Two dimensional system and transform theory; Sampling, linear and non-linear filtering, feature extraction, compression and coding, imaging systems.

16. Mapping of Course Outcomes with Bloom's Taxonomy and Program Outcomes.

After the successful completion of this course, students will be able to:

Sl. No.	COs	POs	Bloom's Taxonomy		
			C	A	P
1	Explain the basic elements of the theoretical foundation of fundamental Digital Image Processing concepts along with image formation and the role of human visual system plays in perception of gray and color image data.	1	1		
	Understand mathematical foundations for digital manipulation of images; image acquisition; preprocessing; segmentation; and compression to the real world problems.		2		
2	Apply the appropriate techniques and tools of the image processing to solve the real world problems.	2	4		
3	Analyze closely related techniques and theories on selected problems on Mathematical Morphology and Image Enhancement in spatial domain, Image Segmentation and Compression, and feature extraction.	5	5		

17. Mapping of COs with Knowledge Profiles, Complex Engineering Problem Solving and Complex Engineering Activities

Course Outcome	Knowledge Profile	Complex Problem Solving	Complex Engineering Activities
CO1	K3		
CO2	K4		
CO3	K5		

Part B

18. Week-wise Course Plan

Week	Topics	Teaching-Learning Strategy	Assessment Strategy	Corresponding COs

1	**Intro to DIP, Course policy, Course outline, Learning and teaching strategy, Evaluation policy. What is DIP, Why do we need DIP? Key stages in DIP and how they works.** **Digital image Representation: Image Types, Reading, Displaying, Writing Images and Data classes using MATLAB.** **Visual Perception and Image formation model, Image Acquisition, Sensors, Image representation.**	- Lecture - Brain Storming Session	- *Class Performance*	1, 2
2	**Image Digitization (Sampling & Quantization), Resolutions (Spatial, Gray/Intensity), dpi resolution, Effects of Spatial and gray level resolutions, How to choose spatial resolutions?** **Pixels & their relationships (neighborhood, adjacency, connectivity, paths and regions).** **Distance matrix (city block, chess board, Euclidean distance), solving exercises on connectivity, paths and distance measure.**	- Lecture -Problem solving	- *Class Performance*	1, 2, 3
3	**Image Enhancement using Arithmetic and Logic operations.** **Some basic Gray Level/Intensity Transformations: (Point processing-LUT, Linear-Negative, Identical,**	- Lecture - Group work	- *Class Performance*	2, 3

	Thresholding, Log, Power Law). Piecewise Linear Transformation (contrast stretching, intensity level slicing, Bit plane slicing).			
4	**What is histogram? Applications of histogram, Normalized histogram, stretching histogram. What is masking? Low pass or Smoothing spatial filters (mean, weighted mean filter), Different filtering design and their applications. Different types of noise, different kinds of noise reduction techniques using filters, Non-linear Median filter, correlation & convolution. Linear Gaussian filter.**	- Lecture - Think – Pair - Share (TPS)	- *Class Performance*	1, 2, 3
5	**Histogram equalization, Equalization transforms functions, Solving exercises on them. Histogram matching specification and local histogram processing. Neighborhood operations, What is masking? Smoothing spatial filters: (mean, weighted mean filter), Noise removing, correlation & convolution.**	- Lecture - Brain Storming Session	- *Class Performance*	2, 3
6	**Gaussian filter, Non-linear Median filter, different filtering designs and their applications. Sharpening spatial Filters: Image derivatives, Laplacian**	- Lecture - Brain Storming Session - Think – Pair - Share (TPS)	- *Class Performance* - Quiz 1	1, 2, 3

	Filter, Laplacian Image Enhancement, Difference filters, Combining filtering techniques.			
7	**What is morphology? Simple morphological operations: Erosion, Dilation, Opening and Closing operations Compound operations, Morphological Algorithms: Boundary extraction. Region filling. Morphological Image Processing: Hit-and-miss Operation, Thinning, Thickening process. Revision and exercises on Morphological Image Processing**	- Lecture - Group work	- *Class Performance*	1, 3
Midbreak				
8	**Image Segmentation, segmentation problems, different techniques of segmentation. Finding points, lines and edges. Edge detection approach for segmentation Canny edge detection**	- Lecture -Problem solving	- *Class Performance*	2,3
9	**Edge Linking, Hough Transform, Region Based Segmentation. Review on Segmentation and problems solving.**	- Lecture - Brain Storming Session	- *Class Performance* *-Quiz 3*	2, 3
10	**Image Compression: Why do we need compression? Compression Ratio and Relative Data Redundancy, How can we implement compression: Coding redundancy, Spatial and temporal redundancy, Irrelevant information.**	- Lecture - Group work	- *Class Performance*	3

	Information theory review, Image Entropy, Lossy and Loss-free Compression, Different Compression Techniques: Huffman coding.			
11	**Different Compression Techniques: Golomb and Arithmetic coding. LZW coding, Run length encoding (RLE), RLE on Binary Image, RLE on BMP. Review on Image Compression and problems solving.**	- Lecture - Brain Storming Session	- *Class Performance*	1, 2, 3
12	**Color Image Processing: Color fundamentals (Radiance, Luminance and Brightness), Color models (RGB Color Model), CIE Chromacity Diagram. HSI Color model, Converting From RGB To HSI and Vice Versa. RGB Color Cube, Pseudocolor Image Processing.**	- Lecture - Problem Solving	- *Class Performance* - Quiz 4	1, 3
13	Spatial Feature Extraction: What is feature extraction in DIP? Where is feature extraction used? What is the advantage of feature extraction? Different types of feature extractions	- Lecture	- *Class Performance*	1, 2
14	**Review classes**	- Problem Solving	- *Class Performance*	

Part C

19. Assessment and Evaluation

1) Assessment Strategy: ***Class Performance, Quizzes/Assignments, and Final Examination***

2) Marks distribution:

a) Continuous Assessment: ***Class Performance (10), Quizzes/Assignments (20)***

b) Summative: ***Final Examination (70)***

3) Make-up Procedures: ***Carryover/Clearance/Improvement Examination***

Part D

20. Learning Materials

20.1. Required (if any)

1. ***Digital Image Processing (3rd Edition).***
   Authored by: R.C. Gonzalez and R.E. Woods
   Publisher: Prentice Hall, 2008.
2. ***Digital Image Processing and Analysis: Human and Computer Vision Applications with CVIP tools (2nd Edition).***
   Authored by: Scott E Umbaugh

20.2. Recommended (if any)

1. **Course website -** https://classroom.google.com/u/0/c/NDk1NDk4OTk1Mjk0 **[Class Code:** cykjms3**]**

20.1. Others (if any)

Prepared by:	**Checked by:**	**Approved by:**
Signature: _____	Signature: _____	Signature: _____
Name: Prof. Dr. Kazi A Kalpoma **Department: CSE** **Date:**	**Name: H M Zabir Haque** **OBE Program Coordinator, CSE** **Date:**	**Name: Dr. Mohammad Shafiul Alam** **HOD, CSE** **Date:**

Annex-1: PEO of CSE

PEO1 - Professionalism
Graduates will demonstrate sound professionalism in computer science and engineering or related fields.

PEO2 – Continuous Personal Development
Graduates will engage in life-long learning in multi-disciplinary fields for industrial and academic careers.

PEO3 – Sustainable Development
Graduates will promote sustainable development at local and international levels.

Annex-2: Mapping of PEO-PO

	PEO1	PEO2	PEO3
PO1 - Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	√		
PO2 - Problem analysis: Identify, formulate, research and analyze complex engineering problems and reach substantiated conclusions using the principles of mathematics, the natural sciences and the engineering sciences.	√		
PO3 - Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.	√		
PO4 – Investigation: Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.	√		
PO5 - Modern tool usage: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	√		
PO6 - The engineer and society: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.	√		√
PO7 - Environment and sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.	√		√
PO8 – Ethics: Apply ethical principles and commit to professional ethics, responsibilities and the norms of engineering practice.	√		

PO9 - Individual work and teamwork: Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.	√	√	
PO10 – Communication: Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instructions.	√		
PO11 - Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work as a member or a leader of a team to manage projects in multidisciplinary environments.	√		
PO12 - Life-long learning: Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.		√	

Annex-3: Blooms Taxonomy *

Level	Cognitive Domain – Revised Version	Affective Domain	Psychomotor Domain
1	Remember (1)	Receiving Phenomena (1)	Perception (1)
2	Comprehend (2)	Responding to Phenomena (2)	Set (2)
3	Apply (3)	Valuing (3)	Guided Response (3)
4	Analyse (4)	Organizing Values (4)	Mechanism (4)
5	Evaluate (5)	Internalising Values (5)	Complex Overt Response (5)
6	Create (6)		Adaption (6)
			Origination (7)

* Based on "REVISED BLOOM'S TAXONOMY INDICATOR v3.31" , available athttp://adept.mmu.edu.my/wp-content/uploads/2018/09/Blooms-Taxonomy-Indicator-v3.31.xls