Ahsanullah University of Science and Technology Bangladesh

COURSE OUTLINE

Part A

1. Course No./Course Code: *CSE4213 (BNQF 061)*

2. Course Title: **Pattern Recognition**

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

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

5. Academic Session: *Spring 2022*

6. Course Teacher/Instructor: Faisal Muhammad Shah

7. Pre-requisite(s) (if any): MATH2203: Mathematics- IV, CSE4107: Artificial Intelligence

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

15: Course Objectives: Introduction: Object features, classifications and learning; Statistical, structural and hybrid methods. Bayesian classifier and Bayesian decision theory. Learning algorithms: Perceptron algorithm and its variants, backpropagation algorithm and its variants. Pattern grammars, languages, parsing techniques and clustering. Application of pattern recognition methods to speech recognition, remote sensing, biomedical area and computer aided design.

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

SI. No.	COs	POs	Bloom's Taxonomy		
			C	A	P
1	Define the basics topics of pattern recognition such as supervised and unsupervised learning, Bayesian decision theory, Parametric and Nonparametric estimation and different types of classifiers.	1	2		
2	Apply the classification and clustering techniques to detect and characterize patterns in real world labeled and unlabeled data.	2	3		
3	Analyze a real world problem by the pattern recognition techniques for prospective and alternative solutions.	4	4		

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	K8		

Part B

18. Week-wise Course Plan

Week	Topic	Teaching-Learning Strategy	Assessment Strategy	Corresponding COs
1	**Introduction to pattern recognition (PR):** Pattern Recognition System, The Design Cycle, Application of Pattern Recognition ,Learning and Adaptation.	- Lecture - Brain Storming Session	- Class Performance	1,3

2	**Linear Discriminant Functions and Decision surface:** The Two-Category Linearly Separable Case: Geometry and Terminology, Gradient Descent Procedure, Two-category case, Multi-category case.	*- Lecture*	*- Class Performance*	*1,2*
3	Generalized Linear Discriminant Function Training algorithm : The perceptron criterion function, Perceptron algorithm example solution.	*- Lecture - Think – Pair - Share (TPS)*	*- Class Performance*	*1,2*
4	**Support Vector Machine(SVM):** Introduction to SVM, Properties of SVM, Solving the optimization problem, Non-linear SVM, SVM applications.	*- Lecture - Brain Storming Session*	*- Class Performance*	*1, 2, 3*
5	**Bayesian Decision Theory:** Introduction to Bayes Decision Rule, Minimum error Rate Classification, Normal Density: Univariate and Multivariate Case, Discriminant Functions for the Normal Density	*- Lecture - Think – Pair - Share (TPS)*	*Quiz 1*	*1,2,3*
6	Risks and Errors, Minimum Risk Classification, Bayesian Networks and Compound Decision Theory.	*- Lecture - Brain Storming Session*	*- Class Performance*	*1,2,3*
7	**Maximum-Likelihood and Bayesian Parameter Estimation:** Maximum Likelihood Estimation: The General Estimation, The Gaussian Case, Bayesian Parameter Estimation : The Univariate Case, The Multivariate Case.	*- Lecture*	*- Class Performance*	*1,2,3*
8	**Naïve Bayes classifier and Bayesian belief networks**	*- Lecture - Brain Storming Session*	*- Quiz 2*	*1,2,3*
9	**Ensemble Learning:** Bagging and Boosting	*- Lecture - Brain Storming Session*	*- Class Performance*	*1.2*

10	**Feature Extraction and Dimensionality Reduction:** Principal Component Analysis (PCA): Data Presentation, Eigen Values and Eigen Vectors, Method and Derivation of PCA, Example and Application of PCA.	*- Lecture* *- Think – Pair - Share (TPS)*	*- Class Performance*	*1,2,3*
11	Linear Discriminant Analysis (LDA): Supervised Feature Extraction, Fisher Mapping, Method and Derivation of LDA, Example and Application of LDA.	*- Lecture* *- Think – Pair - Share (TPS)*	*- Quiz 3*	*1,2,3*
12	**Unsupervised Learning:** Clustering Basics, Partitioning Based Clustering: K-Means Clustering, Hierarchical Based Clustering: Agglomerative and Divisive Clustering.	*- Lecture* *- Brain Storming Session*	*- Class Performance*	*1, 2, 3*
13	**Performance Analysis:** ROC Curve, Cross-fold Validation, Confusion Matrix	*- Lecture* *- Brain Storming Session*	*- Design Project Assignment # 1*	*1,2*
14	Review of Course Contents	*- Lecture*	*- Class Performance*	*1,2,3*

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. **"Pattern Classification", Wiley 2002 by R.O.Duda, P.E. Hart & D. Stork (2nd Edition).**

2. **"Pattern Recognition", Academic Press 2009 by S. Theodoridis and K.Koutroumbas (4th Edition).**
3. *Course Website – https://classroom.google.com/c/NTY5OTcwNjQ0NjQx CSE 4213 – Pattern Recognition (Spring 2022)*

20.2. Recommended (if any)

20.1. Others (if any)

Prepared by:	Checked by:	Approved by:
Signature: _____	Signature: _____	Signature: _____
Name: Faisal Muhammad Shah Department: CSE Date:	Name: OBE Program Coordinator, CSE Date:	Name: 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