Postgraduate Certificate in Data Analysis and Pattern Recognition

1 Title of Certificate: ***Postgraduate Certificate in Data Analysis and Pattern Recognition***

1.1 **Title of Award: Postgraduate Certificate in Data Analysis and Pattern Recognition**

1.2 **Programme Type**: A (***Taught Programme)***

1.3 **Programme Mode**: ***Part-time***

2 Extended Eligibility Requirements

The selection of students to the Postgraduate Certificate will be made by the Department of Computational Mathematics, in accordance with the following extended eligibility requirements, approved by the Senate.

2.1 A degree in Information Technology, Computer Science, Engineering or equivalent from a recognized university **or**

2.2 A degree in Science of at least three years duration in a relevant field of specialization, **with** a minimum of **six** months of recognized appropriate experience, as may be judged by the Faculty of Information Technology and approved by the Senate, **or**

2.3 Any recognized category of membership of a recognized Professional Institute, obtained through an academic route, **with** a minimum of **six** months of recognized appropriate experience, as may be judged by the Faculty of Information Technology and approved by the Senate.

Curriculum and Syllabi

Module Code	Module Title	Credits
CM 5901	Mathematical and Statistical Foundation	4
CM 5902	Natural Language Processing	2
CM 5903	Machine Translation	2
CM 5904	Applied Machine Learning	4
CM 5905	Neural Network for Pattern Recognition	2
CM 5906	Rough Set for Pattern Recognition	2
CM 5907	Project	4
	Total	20

Module Code	CM 5901	Module Title	Mathematical and Statistical Foundation		Compulsory
Credits	4	Hours / Week	Lectures	4	Pre-requisites: None
			Lab / Tutorials	-	

Learning Outcomes

On successful completion of this course module students will be able to:

- Compute mathematical problems
- Analyze a dataset using statistical approaches
- Apply basic mathematical concepts to model real problems
- Compare and contrast different statistical approaches on a given dataset.

Outline Syllabus

- Matrices and Operations
- Theory of Probability
- Bayes' Theorem
- Introduction to Distribution
- Sampling Design
- Descriptive Statistics
- Statistical Graphics and Languages
- Estimation
- Hypotheses Testing
- Chi-Square Test
- Stochastic Processes

Module Code	CM 5902	Module Title	Natural Language Processing		Compulsory
Credits	2	Hours / Week	Lectures	2	Pre-requisites: None
			Lab / Tutorials	-	

Learning Outcomes

On successful completion of this course module students will be able to :

- Develop formal models for representing syntax of sentences, and discourse.
- Describe standard algorithms that use for language processing
- Analyze semantics of words, sentences.
- Develop interpretable semantic representations

Outline Syllabus

- Regular Expressions
- Morphology
- Language modeling
- Hidden Markov Models
- Text Categorization
- Grammar Formalisms
- Parsing
- Lexical semantics
- Discriminative modeling
- Sentence semantics

Module Code	CM 5903	**Module Title**	Machine Translation		**Compulsory**
Credits	2	**Hours / Week**	**Lectures**	2	**Pre-requisites** None
			Lab / Tutorials	-	

Learning Outcomes

On successful completion of this course module students will be able to :

- Design machine translation systems
- Develop discriminative models.
- Evaluate different translation models on a given human language
- Design and justify an approach to the evaluation of the system using tools and metrics

Outline Syllabus

- Probability and Language Models
- Latent Variable Models and Word Alignment
- Lexical Translation Models
- Dynamic Programming
- Decoding
- Phrase-based translation
- Evaluating machine translation
- Feature-based models
- Discriminative learning
- Synchronous grammars
- Parallel Corpora

Module Code	CM 5904	Module Title	Applied Machine Learning		Compulsory
Credits	4	Hours / Week	Lectures	4	Pre-requisites: None
			Lab / Tutorials	-	

Learning Outcomes

On successful completion of this course module students will be able to:

- Describe machine learning approaches.
- Evaluate feasibility of various machine learning techniques against a dataset.
- Combine learning approaches that suit to a given dataset.
- Demonstrate applicability of a learning approach on a given dataset.

Outline Syllabus

- Bayesian methods
- Naive Bayes Classification
- Decision -Tress
- Linear regression
- Logistic Regression
- Optimization
- Support vector machines
- Nearest neighbor method
- K-means clustering
- Mixture models and the EM algorithm
- Hierarchical clustering

Module Code	CM 5905	Module Title	Neural Network for Pattern Recognition		Compulsory
Credits	2	Hours / Week	Lectures	2	Pre-requisites: None
			Lab / Tutorials	-	

Learning Outcomes

On successful completion of this course module students will be able to :

- Explain the features of different neural network architectures.
- Implement network architectures using a programming language
- Assess the applicability of different neural network architectures on a given dataset.
- Develop hybrid neural network architectures for a given dataset.

Outline Syllabus

- Types of neural network architectures
- Perceptron Learning Algorithm
- Back propagation
- Convolutional nets for object recognition
- Radial Basis Networks
- Self-Organizing Maps
- Associative Memory
- Boltzmann Machines
- Introduction to Deep Learning

Module Code	CM 5906	**Module Title**	Rough Set for Pattern Recognition		**Compulsory**
Credits	2	**Hours / Week**	**Lectures**	2	**Pre-requisites** None
			Lab / Tutorials	-	

Learning Outcomes

On successful completion of this course module students will be able to :

- Apply theories of rough set to a given dataset
- Recognize the critical patterns in dataset using Rough set theory
- Design approaches based on Rough set theory to solve a problem
- Evaluate other approaches against Rough set approach

Outline Syllabus

- Rough set theory
- Basic Concepts of Rough Set theory
- Set Approximation
- Rough Membership
- Applications of Rough set theory
- Rough set methodology in pattern extraction

<table>
<tr><td>Module Code</td><td colspan="2">CM 5907</td><td>Module Title</td><td colspan="3">Project</td><td>Compulsory</td></tr>
<tr><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2" colspan="2">Hours / Week</td><td>Lectures</td><td>-</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Lab / Tutorials</td><td>6</td></tr>
<tr><td colspan="8"><u>Learning Outcomes</u>

On successful completion of this module students will be able to design, and implement project of their choice, which will address an innovative issue of the knowledge society.</td></tr>
<tr><td colspan="8"><u>Outline Syllabus</u>

• Design and develop a complete data science based project of their choice.
• Demonstrate and present the result in written and oral form.</td></tr>
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