<table>
<thead>
<tr>
<th>Subject Code</th>
<th>EIE522</th>
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<tbody>
<tr>
<td>Subject Title</td>
<td>Pattern Recognition: Theory and Applications</td>
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<tr>
<td>Credit Value</td>
<td>3</td>
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<tr>
<td>Level</td>
<td>5</td>
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<tr>
<td>Pre-requisite/ Co-requisite/ Exclusion</td>
<td>Nil</td>
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**Objectives**

This course offers an up-to-date review of the state of the art in pattern recognition. In particular, it outlines the need for pattern recognition, its different algorithms, decision theoretic, syntactic, and neural network approaches including learning algorithms, and different classical image processing and character recognition techniques. The course will emphasize practical techniques for implementing useful pattern recognition systems. It will also provide a base for practice and progress in matters related to research.

**Intended Learning Outcomes**

Upon completion of the subject, students shall be able to

- a. Understand and analyze methods for automatic training of classification systems based on typical statistical, syntactic and neural network approaches;
- b. Understand common feature extraction methods for pattern recognition;
- c. Design systems and algorithms for pattern recognition;
- d. Implement typical pattern recognition algorithms in MATLAB;
- e. Present ideas and findings effectively; and
- f. Think critically and learn independently.

**Subject Synopsis/ Indicative Syllabus**

1. **Introduction**
   1.1 The Subproblems of Pattern Recognition
   1.2 Structure of a Pattern Recognition System
   1.3 Patterns and Pattern Vectors

2. **Feature Extraction and Applications**
   2.1 Edge-Detection Methods
   2.2 Shape Characterization
   2.3 Texture Analysis
   2.4 Colour Features
   2.5 People Detection and Face Recognition

3. **Statistical Approaches to Pattern Recognition**
   3.1 Approaches to Developing StatPR Classifier
   3.2 Bayesian Theorem and Bayesian Classifier
   3.3 Supervised Learning Using Parametric & Nonparametric Approaches
   3.4 Unsupervised Learning and Clustering
   3.5 Case Studies

4. **Subspace Analysis**
   4.1 Principal Component Analysis
   4.2 Linear Discriminant Analysis
   4.3 Applications to Face Detection and Recognition
5. Support Vector Machines
   5.1 SVM Principles
   5.2 Linear SVM’s
   5.3 Nonlinear SVM’s
   5.4 Applications of SVM’s

6. Random Forest
   6.1 Decision Tree
   6.2 Random-forest Training
   6.3 Forest Ensemble
   6.4 Applications of Random Forests

7. Neural Networks and Their Applications to Pattern Recognition
   7.1 Artificial Neural Networks: Architectures, Output Characteristics, and Learning Algorithms
   7.2 Neural Network Structures for Pattern Recognition
   7.3 Multilayer Feedforward Networks and Backpropagation Training Algorithms
   7.4 Unsupervised Feature Learning and Deep Learning
   7.5 Case Studies

**Laboratory Exercises:**

(1) Face Image Analysis and Representation Using Principal Component Analysis
(2) Design of Neural Network PR Systems

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<thead>
<tr>
<th>Teaching/Learning Methodology</th>
<th>Intended Subject Learning Outcomes</th>
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<tr>
<td>Lectures</td>
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<td>Tutorials</td>
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<td>Laboratories</td>
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<td>Assignments</td>
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### Assessment Methods in Alignment with Intended Learning Outcomes

<table>
<thead>
<tr>
<th>Specific assessment methods/tasks</th>
<th>% weighting</th>
<th>Intended subject learning outcomes to be assessed (Please tick as appropriate)</th>
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<tbody>
<tr>
<td>1. Tests</td>
<td>25%</td>
<td>✔ ✔ ✔ ✔ ✔ ✔</td>
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<tr>
<td>2. Final examination</td>
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<td>✔ ✔ ✔ ✔ ✔ ✔</td>
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<td>3. Assignments</td>
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<td>✔ ✔ ✔ ✔ ✔ ✔</td>
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<td>4. Laboratories (including report writing)</td>
<td>15%</td>
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<td>Total</td>
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### Student Study Effort Expected

#### Class contact:
- Lecture: 26 Hrs.
- Tutorial: 7 Hrs.
- Laboratory: 6 Hrs.

Other student study effort:
- Self-learning: 36 Hrs.
- Assignments, laboratory report writing: 18 Hrs.

Total student study effort: 93 Hrs.

### Reading List and References

12. Selected papers from Pattern Recognition, Pattern Recognition Letters, IEEE Transactions on Pattern Analysis and Machine Intelligence, and other journals on pattern recognition.

June 2018