## DEPARTMENT OF ECE

## NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

| COURSE PLAN – PART I | | | |
|---|---|---|---|
| Course Title | Pattern recognition and computational intelligence – M.Tech - 2nd Semester | | |
| Course Code | EC628 | No. of Credits | 3 |
| Course Code of Pre-requisite subject(s) | Nil | | |
| Session | Jan. | Section (if, applicable) | Nil |
| Name of Faculty | Dr.E.S.Gopi | Department | ECE |
| Email | esgopi@nitt.edu | Telephone No. | 9500423313 |
| Name of Course Coordinator(s) (if, applicable) | | | |
| E-mail | govivasig@gmail.com | Telephone No. | 914312503314 |
| Course Type | ☐ Core course | ☑ Elective course | |

**Syllabus (approved in BoS)**

Polynomial curve fitting – The curse of dimensionality - Decision theory - Information theory - The beta distribution - Dirichlet distribution-Gaussian distribution-The exponent family: Maximum likelihood and sufficient statistics -Non-parametric method: kernel-density estimators - Nearest neighbour methods. Linear models for regression and classification: Linear basis function models for regression - Bias variance decomposition-Bayesian linear regression-Discriminant functions - Fisher's linear discriminant analysis (LDA) - Principal Component Analysis (PCA) - Probabilistic generative model - Probabilistic discriminative model-Independent Component Analysis (ICA) Kernel methods: Dual representations-Constructing kernels-Radial basis function networksGaussian process-Maximum margin classifier (Support Vector Machine) –Relevance Vector Machines-Kernel-PCA, Kernel-LDA. Mixture models: K-means clustering - Mixtures of Gaussian - Expectation-Maximization algorithm-Sequential models: Markov model, Hidden-Markov Model (HMM) - Linear Dynamical Systems (LDS). Neural networks: Feed- forward Network functions-Network training - Error Back propagation - The Hessian Matrix - Regularization in Neural Network - Mixture density networks – Bayesian Neural Networks - Particle swarm optimization-Genetic algorithm-Ant colony optimizationBacterial foroging-Simulated annealing – Fuzzy logic systems

**COURSE OBJECTIVES**

The subject aims to make the students to understand the mathematical approach for pattern recognition and computational intelligence.

**COURSE OUTCOMES (CO)**

| Course Outcomes | Aligned Programme Outcomes (PO) |
|---|---|
| **PO1: Post graduates of communication engineering programme will demonstrate deep knowledge with an ability to discriminate, evaluate, analyse and synthesize existing and new knowledge in telecommunication engineering and the related mathematics.** | |

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| **PO11: Post graduates should be capable of self-education and clearly understand the value of achieving perfection by learning by mistakes without depending on external feedback.** | |
| At the end of the course student will be able to,<br>CO1: summarize the various techniques involved in pattern recognition. | **PO1** |
| CO2: identify the suitable pattern recognition techniques for the particular applications. | **PO1,PO11** |
| CO3: categorize the various pattern recognition techniques into supervised and unsupervised | **PO1** |
| CO4: summarize the mixture models based pattern recognition techniques | **PO1** |
| CO5: summarize the various computational intelligence techniques for pattern recognition. | **PO1** |

## COURSE PLAN – PART II

**COURSE OVERVIEW**

The subject aims to make the students to understand the mathematical approach for pattern recognition and computational intelligence. The subject deals with Polynomial curve fitting, Linear and Non-linear model for regression and classification. Kernel methods. Mixture models and Biologically inspired algorithms such as Back propagation Neural network, Particle swarm optimization, etc

**COURSE TEACHING AND LEARNING ACTIVITIES**

| S.No. | Week /Contact Hours | Topic | Mode of Delivery |
|---|---|---|---|
| 1 | 1 | Linear model for regression and classification.<br>Polynomial curve fitting<br>The curse of dimensionality<br>Decision theory | Lecture using board and slide presentation |
| 2 | 2 | Information theory The beta distribution<br>Dirichlet distribution,Gaussian distribution<br>The exponent family | Lecture using board and slide presentation |
| 3 | 3 | Maximum likelihood and sufficient statistics.<br>Non parametric method: kernel<br>density estimators Nearest neighbor methods | Lecture using board and slide presentation |
| 4 | 4 | Linear basis function models for regression Bias variance decomposition Linear basis function models for regression Bias variance decomposition | Lecture using board and slide presentation |
| 5 | 5 | Bayesian linear regression Discriminant functions. | Lecture using board and slide presentation |

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|---|---|---|---|
| 6 | 6 | Fisher's linear discriminant analysis (LDA) Principal Component Analysis (PCA) - | **Lecture using board and slide presentation** |
| 5 | 7 | Probabilistic generative model Probabilistic discriminative model Independent Component Analysis (ICA) | **Lecture using board and slide presentation** |
| 6 | 8 | **Flipped class 1** | **Think pair share activity, followed by assessment based on Flipped class 1** |
| 7 | 8 | Kernel methods: Dual representations Constructing kernels Radial basis function networks Gaussian process Maximum margin classifier (Support Vector Machine) | **Lecture using board and slide presentation** |
| 8 | 9 | Relevance Vector Machines Kernel PCA, Kernel LDA. | **Lecture using board and slide presentation** |
| 10 | 10 | Neural networks: Feed forward Network functions Network training Error Back propagation The Hessian Matrix | **Lecture using board and slide presentation** |
| 11 | 11 | **Flipped class 2** | **Think pair share activity, followed by assessment based on Flipped class 2** |
| 12 | 11 | Regularization in Neural Network Mixture density networks Bayesian Neural Networks | **Lecture using board and slide presentation** |
| 13 | 12 | Mixture models: K-means clustering Mixtures of Gaussian | **Lecture using board and slide presentation** |
| 14 | 13 | Expectation Maximization Algorithm | **Lecture using board and slide presentation** |
| 15 | 14 | Sequential models: Markov model, Hidden Markov Model (HMM) Linear Dynamical Systems (LDS) | **Lecture using board and slide presentation** |
| 16 | 14 | Particle swarm optimization Genetic algorithm, | **Lecture using board and slide presentation** |
| 17 | 15 | Ant colony optimization, Bacterial foraging, | **Lecture using board and slide presentation** |

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|---|---|---|---|
| 18 | 15 | Simulated annealing Fuzzy logic systems | Lecture using board and slide presentation |

**COURSE ASSESSMENT METHODS (shall range from 4 to 6)**

| S.No. | Mode of Assessment | Week/Date | Duration | % Weightage |
|---|---|---|---|---|
| 1 | Quiz 1 | During 13/2/ to 16/2 | 1 hour | 15% |
| 2. | Quiz 2 | During 20/3 to 23/3 | 1 hour | 15% |
| CPA | Compensation Assessment | 17/4 to 23/4 | | |
| 3. | Assessment based on flipped class | Contionous assessment | NA | 10% |
| 4 | Min project submission | Audio slide presentation | NA | 10% |
| 5 | End semester exam | During 24/4/ to 14/5 | 3 hours | 50% |

*mandatory; refer to guidelines on page 4

**COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)**

1. Self-assessment feedback by the students
2. Overall performance of the students in the assessment

**COURSE POLICY (preferred mode of correspondence with students, policy on attendance, compensation assessment, , academic honesty and plagiarism etc.)**

**MODE OF CORRESPONDENCE (email/ phone etc)**
esgopi@nitt.edu, 9500423313

**ATTENDANCE**
Minimum attendance requirement is 75% to write the end semester exam

**COMPENSATION ASSESSMENT**
[1] Compensation assessment will be conducted for those who missed either Quiz1 or Quiz 2 (Not both). Portions for the compensation assessment: Quiz 1 + Quiz 2 portions

**ACADEMIC HONESTY & PLAGIARISM**
Copying is strictly not allowed for submitting the project audio slide. However discussion with the peers is allowed.

**ADDITIONAL INFORMATION**

**FOR APPROVAL**

Course Faculty _____ CC-Chairperson _____ HOD _____

(Dr. B. Rebekka)