DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE PLAN – PART I			
Name of the programme and specialization	**M.Tech.**		
Course Title	**Pattern recognition and Computational intelligence (Elective course)**		
Course Code	**EC628**	**No. of Credits**	**3**
Course Code of Pre-requisite subject(s)	**Nil**		
Session	**January 2021**	**Section (if, applicable)**	**Not applicable**
Name of Faculty	**Dr.E.S.Gopi**	**Department**	**ECE**
Official Email	**esgopi@nitt.edu**	**Telephone No.**	**9500423313**
Name of Course Coordinator(s) (if, applicable)	**Not applicable**		
Course Type	**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 networks-Gaussian 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 optimization-Bacterial 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	
MAPPING OF COs with POs	
Course Outcomes	**Programme Outcomes (PO) (**Enter Numbers only**)**
At the end of the course student will be able to, 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**
PO1: Post graduates of communication engineering programme will demonstrate deep knowledge with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge in telecommunication engineering and the related mathematics	
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.	

URSE 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 **(** Add more rows)

S. No.	Week	Topic	Mode of Delivery (ONLINE)
1	**1**	Linear model for regression and classification**.** Polynomial curve fitting The curse of dimensionality Decision theory	**Lecture using board and slide presentation**

2	**2**	Information theory The beta distribution Dirichlet distribution Gaussian distribution The exponent family	**Lecture using board and slide presentation**
3	**3**	Maximum likelihood and sufficient statistics. Non parametric method: kernel 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**
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	**Lecture using board and slide presentation**

		Error Back propagation The Hessian Matrix	
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 Expectation Maximization Algorithm	**Lecture using board and slide presentation**
14	**13**	Sequential models: Markov model, Hidden Markov Model (HMM) Linear Dynamical Systems (LDS)	**Lecture using board and slide presentation**
15	**14**	Particle swarm optimization Genetic algorithm, Ant colony optimization	**Lecture using board and slide presentation**
16	**14**	Bacterial foraging, 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**	**20%**
2.	**Quiz 2**	**During 20/3 to 23/3**	**1 hour**	**20%**
3.	**Assessment based on flipped class Min project submission**	**Contionous assessment**	**-**	**30%**
CPA	**Compensation Assessment***			
5	**Quiz 3**	**During 15/4 to 23/5**		**20%**
6	**Final Assessment ***	**During 24/4 to 14/5**		**30%**

***mandatory; refer to guidelines on page 4**

COURSE POLICY (including compensation assessment to be specified)

[1] Copying is strictly not allowed for submitting the project audio slide. However discussion with the peers is allowed.

[2] The course shall have a final assessment on the entire syllabus with 30% weightage.

[3] Those who missed either Quiz 1 or Quiz 2 for genuine reason are allowed to write Quiz 3 as the Compensation Assessment. The syllabus for the Quiz 3 is the combination of Quiz 1 and Quiz 2 portions. (Only genuine cases of absence shall be considered).

[4] The passing minimum and other policy shall be as per the regulations.

ATTENDANCE POLICY((A uniform attendance policy as specified below shall be followed))

- **At least 75% attendance in each course is mandatory.**
- **A maximum of 10% shall be allowed under On Duty (OD) category.**
- **Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade**

ACADEMIC DISHONESTY & PLAGIARISM

- **Copying from others during an online assessment will be treated as punishable dishonesty.**
- **Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.**
- **The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty.**
- **The report shall be submitted to the Academic office**

ADDITIONAL INFORMATION, IF ANY

Nil

Interaction through piazza (www.piazza.com) is mostly encouraged.

Essential readings:

1. C.M.Bishop,"Pattern recognition and machine learning",Springer,2006
2. E.S.Gopi, „"Algorithm collections for Digital signal Processing application using Matlab, Springer ,2007.
3. Sergious Thedorodis ,Konstantinos Koutroumbas, Patternrecognition, Elsevier, Fourth edition,2009
4.J.I.Tou and R.C.Gonzalez, ``Pattern recognition and Machine learning'', Addition-Wesley, 1977

5.P.A.Devijer and J.Kittler, ``Pattern recognition-A statistical Approach", Prentice-Hall, 1990
6.R.Schalkoff, ``Pattern recognition-statistical ,structural and and Neural approaches",- John Wiley, 1992
7. Recent literature in Pattern recognition and computational intelligence.

FOR APPROVAL

Course Faculty _____ **CC- Chairperson** _____ **HOD** _____