Detailed Syllabus

Lecture-wise Breakup

Course Code	17M11EC121	**Semester** :Even 2022	**Semester** IInd **Session** 2021 -2022 **Month from Feb 2022– June 2022**
Course Name	Statistical Signal Processing		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr.Vineet Khandelwal
	Teacher(s) (Alphabetically)	Dr. Vineet Khandelwal

COURSE OUTCOMES		**COGNITIVE LEVELS**
C116.1	Understand the need of random variables and random processes in signal processing.	Understanding (C2)
C116.2	Experiment with various algorithms to model the random signals.	Applying (C3)
C116.3	Apply and Analyze Wiener and adaptive filters for signal processing applications.	Analyzing (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Review of Linear Algebra, Random Variables and Random Processes	Liner algebra: vectors, linear independence and vector spaces, Matrices: inverse, determinant and trace; Linear equations, quadratic and Hermitian forms, eigenvalues and eigenvectors; Random variables: Jointly distributed random variables, Joint moments, Linear mean square estimation, bias and consistency; Random process : ensemble averages, Gaussian process, stationary process, ergodicity, white noise, Linear system with random input, Spectral factorization theorem and its importance, innovation process and whitening filter.	11
2.	Random Signal Modelling	Least square method, Pade approximation, Prony's method, Stochastic models: MA(q), AR(p), ARMA(p, q)	7

		models.	
3.	Levinson-Durbin Recursion	Development of the recursion, Lattice filter and properties, Different recursion methods	7
4.	Wiener Filtering	FIR Wiener filter: Filtering, Linear prediction , Noise cancellation; IIR Wiener filter: noncausal IIR Wiener filter, causal IIR Wiener filter, causal Wiener filtering and linear prediction, Wiener deconvolution.	7
5.	Adaptive Filtering	Principle and Application, Steepest Descent Algorithm, Convergence characteristics; LMS algorithm, convergence, other LMS based adaptive filters.	6
6.	Spectral Estimation	Non parametric and parametric methods.	3
		Total number of Lectures	**41**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (5 Assignment, 5 Quiz, 5 Class Participation, 10 Attendance)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Monson H. Hayes, "Statistical Digital Signal Processing And Modeling"; John Wiley & Sons, 2004.
2.	Simon Haykin," Adaptive Filter Theory", fifth edition, Pearson, 2013.

Detailed Syllabus

Lecture-wise Breakup

Course Code	20M31EC115	**Semester even**	**Semester II Session** 2021 -2022 **Month from** Feb 22 to Jun 22
Course Name	Deep Learning and Applications		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Neetu Singh
	Teacher(s) (Alphabetically)	Dr. Neetu Singh

COURSE OUTCOMES		**COGNITIVE LEVELS**
C113.1	Compare various loss functions and optimization methods for deep learning approaches	Understanding (C2)
C113.2	Experiment with various CNN architectures for related applications	Apply (C3)
C113.3	Apply and analyze sequence models for related applications	Analyzing (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction and Basic concepts	Introduction to Deep Learning, Bayesian Learning, Decision Surfaces, Linear Classifiers, Linear Machines with Hinge Loss, Optimization Techniques, Gradient Descent, Batch Optimization.	6
2.	Introduction to Neural Networks, Backpropagation and Generalization	Perceptron learning rule and proof of convergence. Performance surfaces and optimum points, Backpropagation: Multilayer Perceptrons, Function Approximation, Performance Index, Chain Rule, Backpropagating the Sensitivities. Various Loss Functions. Vapnik–Chervonenkis dimension.	6

3.	Convolutional Neural Network (CNN) Architectures	Layers for Conv Nets, Feature Maps and Pooling, FC layer to Conv layer conversion, Feature visualization, Batch normalization, Object detection using CNN, CNN architectures: MobileNet, Frequency CNN. Applications of CNN to multimedia.	12
4.	Sequence Models	Recurrent Neural Networks, Adding Feedback Loops and Unfolding a Neural Network, Long Short-Term Memory, Recurrent Neural Network for word predictions, Neural Language Models: Word Embeddings and Word Analogies. Image captioning, Visual question answering, Soft attention, Autoencoders.	12
5.	Generative Adversarial Networks	Introduction to GANs and generative modeling, Various GAN architectures and applications, Deep Reinforcement Learning.	5
Total number of Lectures			41

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (5 Assignment, 5 Quiz, 5 PBL, 10 Attendance)
Total	**100**

Project based learning: Students will apply various CNN models for the image classification and object recognition problems with the help of programming assignments. Additionally, Long Short-Term Memory model in conjunction with CNN will be implemented by the students to study the image captioning and visual question answering. Moreover, every student will prepare a review of the CNN-LSTM applications using current research papers.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Introduction to Deep Learning, S. Kansi, Springer 2018.
2.	Deep Learning, I. Goodfellow, Y, Bengio, A. Courville, MIT Press, 2016.
3.	GANs in Action: Deep learning with Generative Adversarial Networks, J. Langr, V. Bok,

	Manning Publications, 2019.
4.	Pattern Classification- Richard O. Duda, Peter E. Hart, David G. Stork, John Wiley & Sons Inc., 2nd Edition, 2001.

Detailed Syllabus

Lecture-wise Breakup

Course Code	20M32EC113	**Semester** …Even Semester **(specify Odd/Even)**	**Semester 2nd, Session** 2021 -2022 **Month from Feb to May 22**
Course Name	Bio Medical Signal Processing		
Credits	**3**	**Contact Hours**	**3**

Faculty (Names)	**Coordinator(s)**	Mrs.Smriti Bhatnagar
	Teacher(s) (Alphabetically)	Mrs.Smriti Bhatnagar.

COURSE OUTCOMES		**COGNITIVE LEVELS**
C124.1	Recall the Concept of Digital Signal Processing.	C1
C124.2	Introduction of Bio Medical Systems and need and importance of Bio Medical Signal Processing.	C2
C124.3	Generation and acquisition of Bio Medical Signals for different Bio Medical Systems.	C3
C124.4	Applying different Signal Processing Techniques and tools for removing artefacts from acquired Bio Signals and identifying different diseases from data..	C4

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Revision of Fundamentals of Signal Processing and Filter Design	Sampling and aliasing, Signal reconstruction, Signal conversion systems, Circular convolution Correlation-Autocorrelation – Cross correlation, FFT-decimation in time algorithm, Decimation in Frequency algorithm Basics of filter, Design of IR filter-impulse invariant method – Bilinear Transformation Method Warping and pre-warping effect, Frequency transformation, Characteristics of FIR filter and design of FIR filter .	6L
2.	Introduction Different Biomedical Signals and systems.	The Nature and Examples of Biomedical Signals The electrocardiogram (ECG), The electroencephalogram (EEG),The phono cardiograrn(PCG) Basic electrocardiography: ECG lead systems :ECG signal characteristics	12L

3.	Wavelets and and its use as a tool in Bio Signal Processing:	Introduction to wavelets, Time frequency representation, Discrete wavelet transform, pyramid algorithm, Comparison of Fourier transform and wavelet transform, Speech analysis – Cepstrum – Homomorphic filtering of speech signals, ECG signal characteristics – EEG analysis	10L
4.	Analysis of Bio-signals	Automatic analysis and classification of ECG, P-wave detection, QRS complex detection, Correlation analysis of ECG signals, Signal averaged ECG, Analysis of Heart Rate variability, Synchronized averaging of PCG envelopes, Analysis of PCG signal, Analysis of EMG signal	12L
		Total number of Lectures	**40 L**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	C.Reddy "Biomedical Signal Processing: Principles and techniques", Tata McGraw Hill, New Delhi, 2005.
2.	Biomedical signal analysis-A Case-Study Approach, Rangaraj M Rangayan (Wiley-Interscience, John Wiley & Sons, Inc)
3.	
4.	.Digital Signal Processing, Principles Algorithms and Applications, Third edition; John G, Proakis and Dimitris G Manolakis (Prentice Hall)

Detailed Syllabus

Lecture-wise Breakup

Course Code	20M31EC116	**Semester:** Even **(specify Odd/Even)**	**Semester 2nd Session 2021-22** Month from Jan 2022 to May 2022
Course Name	Hybrid Intelligent System		
Credits	4	**Contact Hours**	3-1-0
Faculty (Names)	**Coordinator(s)**	Dr. Ruby Beniwal	
	Teacher(s) (Alphabetically)	Dr. Ruby Beniwal	

COURSE OUTCOMES- At the completion of the course, students will be able to		**COGNITIVE LEVELS**
CO1	Identify and describe hybrid techniques and their roles in building intelligent system	Understanding Level (C2)
CO2	Apply Neuro- fuzzy logic and reasoning to handle uncertainty and solve engineering problems.	Applying Level (C3)
CO3	Effectively use modern software tools to solve real problems using a hybrid approach and evaluate various hybrid computing approaches for a given problem	Evaluating Level(C 5)

Module No.	**Title of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction of neural network	Introduction to neural network Single layer and Multilayer neural network and Associative Memory network,Feedback netwok,Support Vector Machine and its application	7
2.	Introduction of fuzzy logic and Genetic algorithm	Introduction fuzzy set theory ,membership function and operation fuzzy system .fundamental of genetic algorithms and modeling	7
3.	Hybrid system	Introduction of hybrid system, Sequential, Auxiliary and Embedded hybrid system	2
4.	Neuro Fuzzy Modelling:	Adaptive Neuro-Fuzzy Inference Systems, Architecture, Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS	10

		and RBFN, Coactive Neuro Fuzzy Modeling, Framework Neuron Functions for Adaptive Networks, Neuro Fuzzy Spectrum. Introduction to Neuro Fuzzy Control.	
5.	Fuzzy Back propagation Network	LR type Fuzzy numbers and operations on it,fuzzy neuron ,fuzzy BP architecture, learning in fuzzy BP and interference by fuzzy BP and its application	5
6.	Genetic Algorithm based back propagation network	GA based weight determination ,coding, weight extraction fitness function ,reproduction and convergences and its application	7
7.	Simplified Fuzzy ARTMAP and Associative Memories	Fuzzy ARTMAP and its working ,introduction of FAM and Fuzzy Hebb FAM	7
		Total number of Lectures	**45**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25(Attendance, Performance. Assignment/Quiz)
Total	**100**

Project Based Learning : Students will learn different type algorithms based on Neuro- Fuzzy logic and Neuro-Genetic algorithm through Assignments in the area of Hybrid Intelligent System. Additionally, students in group sizes of two-three required to implement any one application of Hybrid Intelligent System one or more research publications.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	*Larry R. Medsker, Hybrid Intelligent Systems 1995th*
2.	Simon Hykins, Neural Networks And Learning Machines, Pearson Publishing House, 2016
3.	S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley - India, 2018
4.	Clinton Sheppard, Genetic Algorithms with Python CreateSpace Independent Publishing Platform ,April 29, 2016
5.	S. Rajasekaran and G. A. vijayalakshmi Pai, Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications ,PHI-2013

Detailed Syllabus

Lab-wise Breakup

Course Code	20M35EC112	**Semester** Even **(specify Odd/Even)**	**Semester** 2nd **Session** 2021 -2022 **Month from** Feb - Jun
Course Name	Machine Learning Lab (Python)		
Credits	3	**Contact Hours**	6

Faculty (Names)	**Coordinator(s)**	Neetu Singh
	Teacher(s) (Alphabetically)	Neetu Singh, Vijay Khare, Vivek Dwivedi

COURSE OUTCOMES: At the completion of the course, students will be able to:		**COGNITIVE LEVELS**
C172.1	Apply Python for implementation of machine learning algorithms to solve real-life problems.	Understanding Level (C2)
C172.2	Apply Python for implementation of ANN and Genetic algorithms to solve real-life problems.	Analysing Level (C4)
C172.3	Apply Python for implementation of deep learning algorithms to solve real-life problems.	Analysing Level (C4)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Parametric regression	Fit the data points using a parametric Regression algorithm for the given data set.	C172.1
2.	Non-parametric regression	Fit the data points using a non-parametric Regression algorithm for the given data set.	C172.1
3.	Bayesian Learning	Implementation of naive Bayesian Classifier model to perform classification between images of the given image data set.	C172.1
4.	Bayesian Network	Construction of a Bayesian network classifier on medical data and demonstration of the diagnosis of a disease using standard	C172.1

		Disease Data Set.	
5.	Unsupervised Learning (Clustering)	Implement/Demonstrate EM, k-means algorithm for clustering of the given data. Compare the efficiency of two algorithms in clustering.	C172.1
6.	Supervised Learning (KNN and SVM)	Implement/Demonstrate k-Nearest neighbour algorithm (KNN) and Support Vector Machines (SVM) to classify a given standard data set.	C172.1
7.	Decision Trees	Implementation of the working of the decision tree based ID3 algorithm.	C172.1
8.	Evaluating Hypothesis	For a given set of training data, implementation of the FIND-S algorithm for finding the most specific hypothesis.	C172.1
9.	Neuron model	Implement the basic logic gates using basic neuron model.	C172.2
10.	Perceptron	Create a single layer perceptron with appropriate number of inputs and outputs. Train it using a fixed increment learning algorithm until no change in weights is required. Output the final weights.	C172.2
11.	Back propagation	Write a program to implement multilayer neural network with back propagation algorithm for given data .	C172.2
12.	RBF Neural network	Write a program to implement multilayer neural network with back propagation algorithm for given data	C172.2
13.	Neuron model	Implement the basic logic gates using basic neuron model	C172.2
14.	Genetic Algorithms	Implement travelling salesperson problem (TSP) using genetic algorithms. Outline learning rule, perceptron, back propagation, fuzzy logic and genetic algorithms.	C172.2
15.	Keras	Introduction to Python deep learning with Keras.	C172.3
16.	CNN	Implementation of a Convolutional Neural Network (CNN) for image classification.	C172.3
17.	Tuning CNN	Tune implemented CNN for better accuracy, convergence rate and lesser training time.	C172.3
18.	RNN	Implementation of Recursive Neural Network (RNN) for text	C172.3

		classification.	
19.	RNN	Implementation of Recursive Neural Network (RNN) for speech recognition.	C172.3
20.	Deep belief network	Implementation of unsupervised learning (deep belief network) for image recognition.	C172.3

Evaluation Criteria

Components	**Maximum Marks**
Viva 1 (Mid Sem Viva)	20
Viva 2 (End Sem Viva)	20
Assessment Components	30
Attendance	15
Lab Record	15
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	R. DUDA, H. PETER , and S. DAVID Stork: Pattern Classification, 2nd ed. New York, NY: Wiley-Interscience, 2000.
2.	T. MITCHELL: Machine Learning, New York, NY: McGraw-Hill, 1997.
3.	M. GOPAL: Applied Machine Learning, M. Gopal, McGraw Hill, 2018.
4.	E. ALPAYDIN: Machine Learning: The New AI, The MIT Press Essential Knowledge series, 2016.
5.	R. C. GONZALEZ, R. E. WOODS: Digital Image Processing, 4th edition, Pearson Education Inc, 2018.
6.	S. DEY: Hands-On Image Processing with Python, Packt Publishing, 2018.

Detailed Syllabus

Lecture-wise Breakup

Subject Code	**17M11EC129**	**Semester Even**	**Semester 2nd Session** 2021-22 **Month from** Jan 22 to Jun 22
Subject Name	**Project Based Learning - I**		
Credits	2	**Contact Hours**	2

Faculty (Names)	**Coordinator(s)**	Dr. Vivek Dwivedi
	Teacher(s) (Alphabetically)	NA

COURSE OUTCOMES		**COGNITIVE LEVELS**
C171.1	Summarize the contemporary scholarly literature, activities, and explored tools/ techniques/software/hardware for hands-on in the respective project area in various domain of Embedded Systems, Signal Processing, VLSI, Communication, Artificial Intelligence and Machine Learning/Deep Learning etc.	Understanding (Level II)
C171.2	Analyze/ Design the skill for obtaining the optimum solution to the formulated problem with in stipulated time and maintain technical correctness with effective presentation.	Analysing (Level IV)
C171.3	Use latest techniques and software tools for achieving the defined objectives.	Evaluating (Level V)
C171.4	Evaluate /Validate sound conclusions based on analysis and effectively document it in correct language and proper format.	Evaluating (Level V)

Project Based Learning Component: Every student will be assigned a project supervisor. The project supervisor will assign 4 different tasks to the student. These tasks will be evaluated by a panel of examiners in the mid and end semester. The students will explore various tools/ techniques/software/hardware for hands-on in the respective project area in various domain of Embedded Systems, Signal Processing, VLSI, Communication, Artificial Intelligence and Machine Learning/Deep Learning etc.

Evaluation Criteria	
Components	**Maximum Marks**
Mid Sem Evaluation 40	
Final Evaluation 40	
Report	20
Total	**100**

Detailed Syllabus
Lecture-wise Breakup

Subject Code	**19M13HS111**	**Semester: Even**	**Semester: M.Tech II & Dual degree VIII Session 2021-22** **Month from February to June 2022**
Subject Name	**English Language Skills for Research Paper Writing**		
Credits	**2**	**Contact Hours**	**2-0-0**
Faculty (Names)	**Coordinator(s)**	Ms. Rashmi Jacob	
	Teacher(s) (Alphabetically)	Ms. Rashmi Jacob	

Course Outcomes:

At the completion of the course, students will be able to,

COURSE OUTCOMES		**COGNITIVE LEVELS**
C204.1	Demonstrate an understanding of all the aspects of grammar and language needed to write a paper.	Understand Level (C2)
C204.2	Apply grammatical knowledge & concepts in writing and presentation.	Apply level (C3)
C204.3	Examine each section of a paper after careful analysis of Literature Review.	Analyze Level (C4)
C204.4	Determine the skills needed to write a title, abstract and introduction, methods, discussion, results and conclusion.	Evaluate Level (C5)
C204.5	Compile all the information into a refined research paper after editing and proofreading	Create Level (C6)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lecturesand Tutorials for the module**
1.	Grammar & Usage	Structure of English Language Voice, Aspect & Tense SVOCA Sense & Sense Relations in English Enhancing Vocabulary Connotation, Denotation & Collocation	**6**
2.	Elements of Paper Writing	Planning & Preparation Word Order Breaking Long Sentences Structuring Paragraphs Being Concise and RemovingRedundancy Avoiding Ambiguity and Vagueness	**4**
3.	Paraphrasing & Writing	Highlighting Your Findings Hedging andCriticising Paraphrasing and Plagiarism Sections of a Paper Abstracts; Introduction	**6**

4.	Process of Writing	Review of Literature Methods Results Discussion Conclusion The Final Check	**4**
5.	Key Skills Needed	Key skills needed when writing a Title Key skills needed whenWriting an Abstract Key skills needed when writing an Introduction Key skills needed when writing a Review of the Literature Key skills needed when writing Methods & Results Key skills needed when writing Discussion & Conclusion	**4**
6.	Refining the Paper	Incorporating useful phrases Editing Proofreading References Annexures Ensuring good quality in submission	**4**
		Total number of Lectures and Tutorials	**28**

Evaluation Criteria	
Components	**MaximumMarks**
Mid Term	30
End Semester Examination	40
TA	30 (Project, Assignment/ Class Test/ Quiz, Class Participation)
Total	**100**

3. Employability/entrepreneurship/skill development

Researchers whose first language is not English write at least two-thirds of published scientific papers. Twenty percent of the comments referees make when reviewing papers for possible publication in international journals regard English language issues. In some disciplines, acceptance rate by journals of papers originating from the US/UK is 30.4%, and is higher than all other countries

Publishing your research in an international journal is key to your success in academia. This course is based on a study of some sample manuscripts and reviewers' reports revealing why papers written by non-native researchers are often rejected due to problems with English usage and poor structure and content. The course prepares the students on how to:

- prepare and structure a manuscript
- increase readability and reduce the number of mistakes you make in English by writing concisely, with no redundancy and no ambiguity
- write a title and an abstract that will attract attention and be read
- decide what to include in the various parts of the paper (Introduction, Methodology, Discussion etc)
- highlight your claims and contribution
- avoid plagiarism
- discuss the limitations of your research
- choose the correct tenses and style
- satisfy the requirements of editors and reviewers

Recommended Reading material:	
1.	Goldbort R. 'Writing for Science', Yale University Press (available on Google Books), 2006
2.	Day R. 'How to Write and Publish a Scientific Paper', Cambridge University Press, 2006
3.	Adrian Wallwork. 'English for Writing Research Papers', Springer, New York, Dordrecht Heidelberg, London, 2011
4.	Yadugari M.A. ' Making Sense of English: A Textbook of Sounds, Words & Grammar' Viva Books Private Limited, New Delhi, 2013, Revised Edition
5.	Strauss Jane. 'The Blue Book of Grammar and Punctuation, Josseybass, Wiley, San Francisco, 1999.
6.	Rizvi, A. R. 'Effective Technical Communication' 2nd edition, McGraw Hill Education Private Limited, Chennai, 2018
7.	Eckert, K. 'Writing Academic Paper in English:Graduate and Postgraduate Level', Moldy Rutabaga Books, 2017
8	Barros, L.O, 'The Only Academic Phrasebook You'll Ever Need: 600 Examples of Academic Language' Create Space Independent Publishing Platform; 1st edition,2016
9	Wallwork, A. 'English for Writing Research Papers (English for Academic Research)'.Springer; 2nd ed. 2016 edition.
10	Wallace,M&Wray,A. 'Critical Reading and Writing for Postgraduates (Student Success) SAGE Publications Ltd; Third edition, 2016
11	Butler, L. 'Longman Academic Writing Series 1: Sentences to Paragraphs, with Essential Online Resources', Pearson Education ESL; 2nd edition,2016
12	Saramäki, J. 'How to Write a Scientific Paper: An Academic Self-Help Guide for PhD StudentsIndependently published, 2018