Detailed Syllabus

Lecture-wise Breakup

Course Code	20M31EC114	**Semester:** Even 2021 **(specify Odd/Even)**	**Semester:** Even **Session:** 2020-21 **Month from: Jan 2021 to June 2021**
Course Name	Digital Image and Video Processing		
Credits	3	**Contact Hours**	3
Faculty (Names)	**Coordinator(s)**	Richa Gupta	
	Teacher(s) (Alphabetically)	Richa Gupta	

COURSE OUTCOMES- At the completion of the course, students will be able to		**COGNITIVE LEVELS**
C115.1	familiarize with the concept of digital image formation, image structure and transform coding.	Applying Level (C3)
C115.2	understand the basics of digital image processing with necessary skills to solve practical problems.	Applying Level (C3)
C115.3	Learn fundamentals of digital video processing, motion estimation and compensation.	Applying Level (C3)
C115.4	Identify the need of image & video compression, and image & video applications.	Applying Level (C3)

Module No.	**Title of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Fundamentals of Digital Image and Image Transform	Basics of digital image processing, Structure of the Picture Information, luminance and chrominance components, RGB components, Transform Coding, Discrete Cosine Transforms – 1 D and 2D. Energy compaction.	6
2.		Image Enhancement - Spatial Domain Processing: Digital Negative, Contrast Stretching, Thresholding, Gray Level Slicing, Bit Plane Slicing, Log Transform and Power Law Transform. Neighborhood Processing: Averaging filters, Order statistics filters,	10

	Digital Image Processing	High pass filters and High boost filters, Filtering in frequency domain: Smoothing and Sharpening filters, Image Segmentation, Image Restoration & Construction, Morphological Image Processing, Image quality assessments.	
3.	Digital Video Processing	Digital Video Sampling and Interpolation, Video Frame Classifications, I, P and B frames, Notation, Motion Estimation and compensation, Application of motion estimation in video coding, Video Enhancement and Restoration, Video quality Assessment.	9
4.	Image Compression and Video Compression	Data Compression: Lossless Compression and Lossy Compression, Optimal codes, Construction algorithms of source codes - Huffman Codes, Error Resilient Codes–types, construction and applications, Basics of Image Compression, Joint Photographic Expert Group (JPEG) compression, Basics of Video Compression, Inter-frame and Intra-frame redundancy, Video Coding Standard – H.263++	10
5.	Image and Video Applications	Image and Video Segmentation, Biomedical Image Processing, Image Annotation, Video Annotation, Video surveillance.	8
		Total number of Lectures	**43**

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 are required to prepare a consolidated summary (including approach, limitations, pros and cons, applications, scope etc.) of any recent research paper published in reputed International Conference or International Journal related to Image and Video processing. They will submit this research assignment towards the end of the semester.

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.	Gonzaleze and Woods, “Digital Image Processing using MATLAB”, 2nd Edition, McGraw Hill Education, 2010.
2.	K. Sayood, Introduction to data compression, Elsevier, 5th edition, 2017
3.	A Murat Tekalp, “Digital Video Processing”, Prentice Hall, 2nd Edition, 2015

Detailed Syllabus

Lecture-wise Breakup

Course Code	20M31EC115	**Semester even**	**Semester II Session** 2020 -2021 **Month from** Jan 21 to May 21
Course Name	Deep Learning and Applications		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Abhinav Gupta
	Teacher(s) (Alphabetically)	Dr. Abhinav Gupta

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Compare various loss functions and optimization methods for deep learning approaches	Understanding (C2)
CO2	Experiment with various CNN architectures for related applications	Apply (C3)
CO3	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 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.	8
2.	Convolutional Neural	Layers for Conv Nets, Feature Maps and Pooling,	14

	Network (CNN) Architectures	FC layer to Conv layer conversion, Feature visualization, Batch normalization, Object detection using CNN, CNN architectures: MobileNet, Frequency CNN. Applications of CNN to multimedia.	
3.	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.	14
4.	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 Class Participation, 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

Detailed Syllabus

Lecture-wise Breakup

Course Code	20M31EC116	**Semester:** Even **(specify Odd/Even)**	**Semester 2nd Session 2020-21** Month from Jan 2021 to May 2021
Course Name	Hybrid Intelligent System		
Credits	4	**Contact Hours**	3-1-0
Faculty (Names)	**Coordinator(s)**	Dr. Vijay Khare	
	Teacher(s) (Alphabetically)	Dr. Vijay Khare	

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	2

		Embedded hybrid system	
4.	Neuro Fuzzy Modelling:	Adaptive Neuro-Fuzzy Inference Systems, Architecture, Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN, Coactive Neuro Fuzzy Modeling, Framework Neuron Functions for Adaptive Networks, Neuro Fuzzy Spectrum. Introduction to Neuro Fuzzy Control.	10
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

Lecture-wise Breakup

Course Code	17M11EC121	**Semester** :Even 2021	**Semester** IInd **Session** 2020 -2021 **Month from Jan2021 –May 2021**
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,	11

		Spectral factorization theorem and its importance, innovation process and whitening filter.	
2.	Random Signal Modelling	Least square method, Pade approximation, Prony's method, Stochastic models: MA(q), AR(p), ARMA(p, q) models.	7
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

Subject Code	**17M11EC120**	**Semester Even**	**Semester 2nd Session** 2020-21 **Month from** Jan 21 to Jun 21
Subject Name	**Project Based Learning - I**		
Credits	2	**Contact Hours**	2

Faculty (Names)	**Coordinator(s)**	Dr. Gaurav Verma
	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**