HINDUSTAN
INSTITUTE OF TECHNOLOGY & SCIENCE
(DEEMED TO BE UNIVERSITY)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

M.Tech. ECE with specialization in Digital Image Processing

CURRICULUM AND SYLLABUS

(Applicable for Students admitted from Academic Year 2020-21)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHOOL OF ELECTRICAL SCIENCES
CHENNAI-603103

HITS - VISION AND MISSION

Motto

To Make Every Man a Success and No Man a Failure.

Vision

To be an International Institute of Excellence, providing a conducive environment for education with a strong emphasis on innovation, quality, research and strategic partnership blended with values and commitment to society.

Mission

- To create an ecosystem for learning and world class research.
- To nurture a sense of creativity and innovation.
- To instill highest ethical standards and values with a sense of professionalism.
- To take up activities for the development of Society.
- To develop national and international collaboration and strategic partnership with industry and institutes of excellence.
- To enable graduates to become future leaders and innovators.

Value Statement

Integrity, Innovation, Internationalization.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING –VISION & MISSION

Vision

To be a premier academic centre for quality education to meet the industrial standards and research in diverse areas of Electronics and Communication Engineering with social commitment.

Mission

M1 To impart adequate engineering knowledge to transform students into highly professional engineers as well as good researchers.

M2 To develop their inter disciplinary skills as per the need of the industry and society.

M3 To inculcate Entrepreneurship and lifelong learning skills among the students with ethics and social commitment.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO I Graduates will demonstrate their knowledge in science and Engineering as problem solvers and researchers.

PEO II Graduates will exhibit skills in cutting edge technologies to solve societal needs in multidisciplinary areas.

PEO III Graduates will develop an attitude towards life long learning and ethics to emerge as socially committed entrepreneurs.

PROGRAM OUTCOMES (PO)

PO 1: **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: **Engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice**.**

PO 9: **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions**.**

PO 11: **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change**.**

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO 1: Able to impart high quality education to the students to face and analyze the challenges in the field of image processing and communication.

PSO 2: Able to analyze, design and validate the systems using hardware and software tools pertaining to Image Processing.

M.Tech. ECE with specialization in Digital Image Processing

CURRICULUM

SEMESTER -1

Sl. No	Course Code	Course Title	L	T	P	C	TCH
THEORY							
1		Applied Mathematics for Electronics Engineers	3	0	0	3	3
2		Research Methodology and IPR	2	0	0	2	2
3	ECA4701	Advanced Digital Image Processing	3	0	0	3	3
4	ECA4702	Pattern Recognition	3	0	0	3	3
5		Department Elective- I	3	0	0	3	3
6		Department Elective- II	3	0	0	3	3
PRACTICAL							
7	ECA4791	Image Processing Lab – 1	0	0	6	2	6
8	ECA4796	Seminar	2	0	0	2	2
Total Credits			**19**	**0**	**6**	**21**	**25**

SEMESTER II

Sl. No	Course Code	Course Title	L	T	P	C	TCH
THEORY							
1	ECA4703	Multimedia Compression Techniques	3	0	0	3	3
2	ECA4704	Image Processing Applications	3	0	0	3	3
3	ECA4705	Medical Imaging Techniques	3	0	0	3	3
4		Department Elective- III	3	0	0	3	3
5		Open Elective	3	0	0	3	3
PRACTICAL							
6	ECA4792	Image Processing Lab - 2	0	0	6	2	6
7	ECA4781	Mini project	2	0	0	2	2
Total Credits			**17**	**0**	**6**	**19**	**23**

SEMESTER III

Sl. No	Course Code	Course Title	L	T	P	C	TCH
THEORY							
1		Department Elective- IV	3	0	0	3	**3**
PRACTICAL							
2	ECA4897	Internship *				2	
3	ECA4898	Project Phase –I	0	0	16	8	**16**
Total Credits			**3**	**0**	**16**	**13**	**19**

*Internship to be undergone during vacation between 2nd and 3rd semesters

SEMESTER IV

Sl. No	Course Code	Course Title	L	T	P	C	TCH
PRACTICAL							
1	ECA4899	Project Phase –II	0	0	24	12	24
Total Credits			**0**	**0**	**24**	**12**	**24**

LIST OF DEPARTMENT ELECTIVES

ELECTIVE I

Sl. No	Course Code	Course Title	L	T	P	C	TCH
1	ECA4721	Wavelet Transform and its application	3	0	0	3	3
2	ECA4722	Python Programming	3	0	0	3	3
3	ECA4723	Introduction to Optimization Techniques	3	0	0	3	3
4	ECA4724	Natural Language Processing	3	0	0	3	3

ELECTIVE II

Sl. No	Course Code	Course Title	L	T	P	C	TCH
1	ECB4705	Machine Learning	3	0	0	3	3
2	ECA4725	Video Processing	3	0	0	3	3
3	ECA4726	Advanced Digital Signal Processing	3	0	0	3	3
4	ECA4727	Computer Vision	3	0	0	3	3

ELECTIVE III

Sl. No	Course Code	Course Title	L	T	P	C	TCH
1	ECA4728	Brain Computer Interface	3	0	0	3	3
2	ECA4729	Cryptography	3	0	0	3	3
3	ECA4730	Visualization Techniques	3	0	0	3	3
4	ECA4731	Deep Learning	3	0	0	3	3

ELECTIVE IV

Sl. No	Course Code	Course Title	L	T	P	C	TCH
1	ECA4732	Bio Signal Processing	3	0	0	3	3
2	ECA4733	Advanced Computer Graphics and Animations	3	0	0	3	3
3	ECA4734	Internet of Things : Foundations and Practices	3	0	0	3	3
4	ECA4735	Retinal Image Analysis	3	0	0	3	3

SEMESTER I

COURSE TITLE	RESEARCH METHODOLOGY & IPR			CREDITS	2
Course Code		Course Category		L-T-P-S	2-0-0-0
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	Understand research problem formulation.	
2.	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.	
3.	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.	
4.	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.	
5.	Analyze research related information and to follow research ethics	

Prerequisites:

MODULE 1 – Research Problem Formulation (9)

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

MODULE 2 –Research Proposal and Ethics (9)

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

MODULE 3 - Data Analysis and interpretation (9)

Classification of Data, Methods of Data Collection, Sampling, Sampling techniques procedure and methods, Ethical considerations in research Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Interpretation of results.

MODULE 4 - Nature of Intellectual Property (9)

Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE 5 – Patent Rights and New Developments in IPR (9)

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCE BOOKS

1	Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students',
2	Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3	Ranjit Kumar, 2 nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4	Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5	Mayall , "Industrial Design", McGraw Hill, 1992.
6	Niebel , "Product Design", McGraw Hill, 1974.
7	Asimov, "Introduction to Design", Prentice Hall, 1962.
8	Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9	T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008
10	C.R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques , New Age
11	International Publishers, Third Edition, Ranjith Kumar, Research Methodology: A Step by step Guide for Beginners, 2nd Edition, SAGE, 2005
12	Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
13	Creswell, John W. Research design: Qualitative, quantitative, and mixed methods, approaches. Sage publications, 2013.

COURSE TITLE	ADVANCED DIGITAL IMAGE PROCESSING			CREDITS	3
Course Code	ECA4701	Course Category	PC	L-T-P-S	3-0-0-0
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	Explain the essentials of digital image processing.	1,2,3
2	Describe various segmentation techniques for image analysis.	1,2,3
3.	Outline the various feature extraction techniques for image analysis.	1,2,3
4	Discuss the concepts of image registration and fusion.	1,2,3
5.	Illustrate 3D image visualization.	1,2,3

Prerequisites:

MODULE 1 – REVIEW OF DIGITAL IMAGE PROCESSING

Steps in digital image processing-Elements of visual perception- brightness adaptation, Mach band effect. Image enhancement in spatial and frequency domain, Histogram equalization

MODULE 2 – SEGMENTATION

Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour models, Texture feature based segmentation, Graph based segmentation, Wavelet based Segmentation - Applications of image segmentation.

MODULE 3 – FEATURE EXTRACTION

First and second order edge detection operators, Phase congruency, Localized feature extraction -detecting image curvature, shape features, Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors- Autocorrelation, Co-occurrence features, Runlength features, Fractal model based features, Gabor filter, wavelet features.

MODULE 4 – REGISTRATION AND IMAGE FUSION

Registration - Preprocessing, Feature selection - points, lines, regions and templates Feature correspondence - Point pattern matching, Line matching, Region matching, Template matching.Transformation functions - Similarity transformation and Affine Transformation. Resampling – NearestNeighbour and Cubic Splines. Image Fusion - Overview of image fusion, pixel fusion, wavelet based fusion -region based fusion.

MODULE 5 – 3D IMAGE VISUALIZATION

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiple connected surfaces, Image processing in 3D, Measurements on 3D images.

TEXT BOOKS

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing',Pearson,Education, Inc.,Second Edition, 2004.

2.	Mark Nixon, Alberto Aguado, “Feature Extraction and Image Processing”, Academic Press,2008.
	REFERENCE BOOKS
1.	Ardeshir Goshtasby, “ 2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications”,John Wiley and Sons,2005.
2.	John C.Russ, “The Image Processing Handbook”, CRC Press,2007.
3.	Anil K. Jain, Fundamentals of Digital Image Processing', Pearson Education, Inc., 2002.
4.	Rick S.Blum, Zheng Liu, “Multisensor image fusion and its Applications“, Taylor&Francis,2006.
E –BOOKS	
1.	John C. Russ, F. Brent Neal-**The Image Processing Handbook, Seventh Edition,** The Kindle edition (2016), **CRC Press,Taylor & Francis Group.**
MOOC	
1.	https://nptel.ac.in/courses/117/105/117105079/
2.	https://nptel.ac.in/courses/117/105/117105135/

COURSE TITLE	PATTERN RECOGNITION			CREDITS	3
Course Code	ECA4702	Course Category	PC	L-T-P-S	3-0-0-0
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	Differentiate between supervised and unsupervised classifiers	1,2,3
2	Outline the concept and importance of clustering in pattern recognition	1,2,3
3.	Extract feature set and select the features from given data set.	1,2,3
4	To interpret the role of Hidden Marko model and SVM in pattern recognition	1,2,3
5.	Apply fuzzy logic and genetic algorithms for classification problems	1,2,3

Prerequisites:

MODULE 1 – PATTERN CLASSIFIER (9)

Overview of Pattern recognition – Discriminant functions – Supervised learning –Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation– Problems with Bayes approach– Pattern classification by distance functions –Minimum distance pattern classifier

MODULE 2 – CLUSTERING (9)

Clustering for unsupervised learning and classification–Clustering concept – C Means algorithm – Hierarchical clustering – Graph theoretic approach to pattern Clustering –Validity of Clusters

MODULE 3 – CLASSIFICATION ALGORITHMS (9)

Template matching - probabilistic approach- K-nearnest neighbour (KNN), Parzen window classifier and branch-and bound methods (BnB)- Gaussian mixture models-Optimum-Path Forest- Fuzzy logic – Fuzzy Pattern Classifiers – Pattern Classification using Genetic Algorithms

MODULE 4 – HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINE

State Machines – Hidden Markov Models – Training – Classification – Support vector Machine – Feature Selection

MODULE 5 – CASE STUDIES (9)

Stock Market Forecasting- Audience research- Text Generation, Text Analysis, Text Translation, Chatbots - Natural Language Processing - Optical Character Recognition- Image Pattern Recognition- Visual Search, Face Recognition- Voice Recognition- AI Assistants, Speech-To-Text, Automatic Subtitling- Sentiment Analysis

TEXT BOOKS

1.	Robert J.Schalkoff, “Pattern Recognition Statistical, Structural and Neural Approaches”, John Wiley & Sons Inc., New York, 1992
2.	R.O.Duda, P.E.Hart and D.G.Stork, “Pattern Classification”, John Wiley, 2001
	REFERENCE BOOKS
1.	M. Narasimha Murthy and V. Susheela Devi, “Pattern Recognition”, Springer 2011.
2.	Andrew Webb, “Stastical Pattern Recognition”, Arnold publishers, London,1999
3.	S.Theodoridis and K.Koutroumbas, “Pattern Recognition”, 4th Ed., Academic Press. 2009
E- BOOKS	
1.	Christopher M. Bishop,’Pattern Recognition and Machine Learning’,Springer publisher,2006.
2.	Y.Ansai,’Pattern Recognition and Machine Learning’, Elsevier publisher, 2012.
MOOC	
1.	https://nptel.ac.in/courses/117108048
2.	https://nptel.ac.in/courses/117/106/117106100

COURSE TITLE	IMAGE PROCESSING LAB -I			CREDITS	2
Course Code	ECA4791	Course Category		L-T-P-S	0-0-3-0
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	Analyze techniques such as image denoising, image segmentation and edge detection.	1,2,3,5
2	Apply spatial and frequency domain filters on an image.	1,2,3,5
3.	Analyze the effects of image transforms.	1,2,3

Prerequisites:

LIST OF EXPERIMENTS

1. **Point-to-point transformation-** Thresholding an image and the evaluation of its histogram.
2. **Histogram Equalization.**
3. **Geometric transformations-** Image rotation, scaling, and translation. Two-dimensional Fourier transform I.
4. **Two-dimensional Fourier Transform**. Harmonic content of an image using the discrete Fourier transform (DFT) and masking with DFT.
5. **Linear filtering using convolution.**
6. **Ideal filters in the frequency domain**- Effects of filtering low and high frequencies in an image.
7. **Non-Linear filtering using convolutional masks-** Effects of a median filter on an image corrupted with impulsive noise.
8. **Morphological operations I.** Erosion and dilation
9. **Entropy as a compression measure-** Entropy as a compression measurement to the DPCM compression measure.
10. **Edge detection-** Edge detectors and their operation in noisy images.

TEXT BOOKS

1.	Rafael C. Gonzalez, Richard Eugene Woods, Steven L. Eddins, Digital Image Processing Using MATLAB, Pearson Education India, 2004.

REFERENCE BOOKS

1	Jayaraman S, Veerakumar T, Esakkirajan S, Digital Image Processing", Mc Graw Hill Education, 2009.
2	Anil K Jain, Fundamentals of Digital Image Processing", Prentice Hall, 1989.
3	Chris Soloman, Toby Breckon, Fundamentals of Digital Image Processing: A Practical Approach with examples in Matlab", Wiley-Blackwell, 2010

E BOOKS

1	https://www.intechopen.com/books/applications-from-engineering-with-matlab-concepts/digital-image-processing-with-matlab

COURSE TITLE	SEMINAR				CREDITS	2
Course Code	ECA4796	Course Category		L-T-P-S	2-0-0-2	
CIA				ESE		
LEARNING LEVEL				ASSESSMENT MODEL		

	COURSE OUTCOMES	PO
1.	Survey the literature on new research areas and compile findings on a particular topic	
2	Organize and illustrate technical documentation with scientific rigor and adequate literal standards on the chosen topic strictly abiding by professional ethics while reporting results and stating claims	
3.	Demonstrate communication skills in conveying the technical documentation via oral presentations using modern presentation tools.	

- The objective of the seminar is to impart training to the students in collecting materials on a specific topic in the broad domain of Engineering/Science from books, journals and other sources, compressing and organizing them in a logical sequence, and presenting the matter effectively both orally and as a technical report.
- The topic chosen by the student shall be approved by the Faculty-in-Charge of the seminar.
- The seminar evaluation committee shall evaluate the presentation of students.
- A seminar report duly certified by the Faculty-in-Charge of the seminar in the prescribed form shall be submitted to the department after the approval from the committee

DEPARTMENT ELECTIVE – I

COURSE TITLE	WAVELET TRANSFORMS AND ITS APPLICATIONS			CREDITS	3
Course Code	ECA4721	Course Category	PE	L-T-P-S	3-0-0-3
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	To understand the fundamentals concepts of wavelet transforms.	1,2,3
2.	To learn system design using Wavelets	1,2,3,9
3.	To learn the different wavelet families & their applications.	1,2,3

Prerequisites: Signal and Systems, Digital Signal Processing

MODULE 1 –Introduction to Wavelets (9)

Introduction to Multirate signal processing- Decimation and Interpolation, Quadrature Mirror Filters, Sub band coding, Limitations of Fourier transform, Short time Fourier transform and its drawbacks, Continuous Wavelet transform, Time frequency representation, Wavelet System and its characteristics, Orthogonal and Orthonormal functions and function space

MODULE 2 - MULTIRESOLUTION CONCEPT AND DISCRETE WAVELET TRANSFORM (9)

Multiresolution formulation of wavelet systems- signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filter banks- Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet Packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.

MODULE 3 – WAVELET SYSTEM DESIGN (9)

Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, Design of Daubechies orthogonal wavelet system coefficients, Design of Coiflet and Symlet wavelets.

MODULE 4 – WAVELET FAMILIES (9)

Continuous Wavelets- Properties of Mexican hat wavelet, Morlet, Gaussian and Meyer wavelets. Orthogonal wavelets- Properties of Haar wavelets, Daubechies wavelets, Symlets, Coiflets and Discrete Meyer wavelets. Properties of Biorthogonal wavelets, Applications of wavelet families.

MODULE 5 – WAVELET APPLICATIONS (9)

Denoising of Signals and Images, Image enhancement, Edge detection, Image Fusion, Image compression, Wavelet based feature extraction, Analysis of phonocardiogram signals, Analysis of EEG signals, Speech enhancement for hearing aids

TEXT BOOKS

1. C.Sidney Burrus, Ramesh Gopinath & Haito Guo, Introduction to wavelets and wavelet transform, Prentice Hall, 1998.
3. Metin Akay, ‘Time frequency and wavelets in biomedical signal processing,’ Wiley-IEEE Press, October 1997.

REFERENCE BOOKS

1.	M.Vetterli and J. Kovacevic,'Wavelets and sub band coding, Prentice Hall, 1995.
2.	P.P.Vaidyanathan, 'Multi rate systems and filter banks', Prentice Hall, 1993
3.	Raguveer m Rao & Ajith S. Bopardikar, 'Wavelet transforms – Introduction to theory and applications, Addison Wesley, 1998.
4.	S.Mallet,'A Wavelet tour of Signal Processing',Academic Press, 1998.
E BOOKS	
1 2.	D.sundararajan,'Discrete Wavelet Transform: A Signal Processing Approach 1st Edition', Kindle Edition. Lokenath Debnath,' Wavelet Transforms and Their Applications,' Birkhäuser Basel publisher,2002
MOOC	
1	https://nptel.ac.in/courses/108101093/
2	https://nptel.ac.in/courses/117101123/

COURSE TITLE	PYTHON PROGRAMMING			CREDITS	3
Course Code	ECA4722	Course Category		L-T-P-S	3-0-0-0
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	To know the basics of algorithmic problem solving	
2.	To execute simple Python programs.	
3.	To develop Python programs with conditionals and loops.	
4	To develop algorithmic solutions to simple computational problems	
5	To represent compound data using Python lists, tuples, dictionaries	
6	To implement input/output with files in Python	

MODULE 1 - ALGORITHMIC PROBLEM SOLVING (9)

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

MODULE 2 -DATA, EXPRESSIONS, STATEMENTS (9)

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

MODULE 3- CONTROL FLOW, FUNCTIONS (9)

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

MODULE 4 - LISTS, TUPLES, DICTIONARIES (9)

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and

methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.	
MODULE 5 – FILES, MODULES, PACKAGES (9)	
Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.	
TEXT BOOKS	
1.	Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)
2.	Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
REFERENCE BOOKS	
1.	Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016
2.	Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015
3.	John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013

COURSE TITLE	INTRODUCTION TO OPTIMIZATION TECHNIQUES			CREDITS	3
Course Code	ECA4723	Course Category		L-T-P-S	3-0-0-0
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	Able to formulate engineering problems as mathematical optimization problems	1,2,3,4,5,6
2	Skilled to apply the concept of linear and nonlinear programming problem to the engineering problem	1,2,3,4,5,6
3.	Competent to apply the concept of integer programming problem to the engineering problem	1,2,3,4,5,6,11
4.	Proficient to recognize the solution for assignment problem and transportation problem for optimal solution	1,2,3,4,5,6,11
5.	Apply bio-inspired techniques in image processing	1,2,3,4,5,11

Prerequisites:

MODULE 1 – INTRODUCTION TO OPTIMIZATION (9)

Introduction to operations research – objective – scope of OR – Limitations of OR – Introduction and formulation of linear programming – Solving LPP using Graphical method.

MODULE 2 – LINEAR PROGRAMMMING PROBLEM (9)

Solving LPP using simplex method – Big-M method – Two phase method – conversion of primal to dual.

MODULE 3 – INTEGER PROGRAMMING (9)

Integer programming – Cutting plane method – Gomory's Mixed integer method – Branch and Bound method

MODULE 4 – ASSIGNMENT AND TRANSPORTATION PROBLEM (9)

Hungarian Method – Maximization and unbalanced assignment problem – Basic feasible solution of transportation problem – Modi method – Degeneracy – Unbalanced Transportation problem.

MODULE 5 – BIOINSPIRED COMPUTING (9)

Genetic Algorithms and Differential Evolution, Swarm Optimization and Firefly Algorithm, Cuckoo Search Algorithm for Image Processing Applications.

TEXT BOOKS

1. Chandrasekaran A, "A Text book of Operation Research", Dhanam Publications, Chennai, 2017
2. V. Sundaresan, K. S. Ganapathy Subramanian, K. Ganesan, "Resource Management

	Techniques", A. R. Publications, 2004
3.	S. D. Sharma, "Operation Research", Kedarnath Ramnath & Co, 2002
	REFERENCE BOOKS
1	Hamdy A. Taha, "Operations Research: An Introduction (9th Edition)", Prentice Hall, 2010
2	D S Hira & Prem Kumar Gupta, "Introduction to Operations Research", S. Chand Publishing, 2012
3	Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.
E BOOKS	
1.	http://nptel.ac.in/courses/112106134/1
2.	https://onlinecourses.nptel.ac.in/noc17_mg10/preview
MOOC	
1.	https://nptel.ac.in/content/storage2/courses/105108127/pdf/Module_1/M1L1slides.pdf

COURSE TITLE	NATURAL LANGUAGE PROCESSING			CREDITS	3
Course Code	ECA4724	Course Category		L-T-P-S	3-0-0-0
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	To identify the different linguistic components of given sentences.	
2.	Design a morphological analyser for a language of your choice using finite state automata concepts.	
3.	Implement the Earley algorithm for a language of your choice by providing suitable grammar and words.	
4.	Use a machine learning algorithm for word sense disambiguation.	
5.	Build a tagger to semantically tag words using WordNet.	

MODULE 1 – MORPHOLOGY AND PART-OF SPEECH PROCESSING (9)

Introduction –Regular Expressions and Automata-Non-Deterministic FSAs.Tranducers –English Morphology –Finite-State Morphological Parsing -Porter Stemmer –Tokenization-Detection and Correction of Spelling Errors. N-grams –Perplexity -Smoothing -Interpolation -Backoff Part-of-Speech Tagging –English Word Classes -Tagsets -Rule-Based -HMM -Transformation-Based Tagging -Evaluation and ErrorAnalysis. Hidden Markov and Maximum Entropy Mode

MODULE 2 - SPEECH PROCESSING (9)

Phonetics –Articulatory Phonetics -Phonological Categories -Acoustic Phonetics and Signals -Speech Synthesis –Text Normalization –Phonetic and Acoustic Analysis -Diphone Waveform synthesis –Evaluation-Automatic Speech Recognition –Architecture -Hidden Markov Model to Speech -MFCC vectors -Acoustic Likelihood Computation -Evaluation. Triphones –Discriminative Training -Modeling Variation.

MODULE 3 – SYNTAX ANALYSIS (9)

Formal Grammars of English –Constituency -Context-Free Grammars –Grammar Rules –Treebanks -Finite-State and Context-Free Grammars -Dependency Grammars. Syntactic Parsing –Parsing as Search -Ambiguity -Dynamic Programming Parsing Methods –CKY-Earley and Chart Parsing-Partial Parsing-Evaluation.

MODULE 4 –SEMANTIC AND PRAGMATIC INTERPRETATION (9)

Representation of Meaning –Desirable Properties -Computational Semantics -Word Senses -Relations Between Senses –WorldNet -Event Participants-Proposition Bank -Frame Net –Metaphor. Computational Lexical Semantics –Word Sense Disambiguation-Supervised Word Sense Disambiguation -Dictionary and Thesaurus Methods-Word Similarity -Minimally Supervised WSD -Hyponymy and Other Word Relations -Semantic Role Labeling -Unsupervised Sense Disambiguation. Computational Discourse -Discourse Segmentation

MODULE 5 –APPLICATIONS (9)

Information Extraction –Named Entity Recognition -Relation Detection and Classification –Temporal and Event Processing -Template-Filling -Biomedical Information Extraction. Question

Answering and Summarization -Information Retrieval -Factoid Question Answering - Summarization -Single and Multi-Document Summarization -Focused Summarization - Evaluation. Dialog and Conversational Agents –Properties of Human Conversations -Basic Dialogue Systems -VoiceXML -Information-State and Dialogue Acts -Markov Decision Process Architecture.	
TEXT BOOKS	
1.	NitinIndurkhya, Fred J. Damerau, "Handbook of Natural Language Processing", (Chapman& Hall/CRC Machine Learning & Pattern Recognition), Second Edition, 2010.
2.	Alexander Clark, Chris Fox, ShalomLappin, "The Handbook of Computational Linguistics and Natural Language Processing", Wiley-Blackwell, 2012
3	Jurafsky and Martin, "Speech and Language Processing", Pearson Prentice Hall, Second Edition, 2008
REFERENCE BOOKS	
1.	Christopher D. Manning and HinrichSchütze, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.
2.	Stevan Bird, "Natural Language Processing with Python", Shroff, 2009.
3.	ames Allen, "NaturalLanguage Understanding", Addison Wesley, Second Edition, 2007.

ELECTIVE – II

COURSE TITLE	MACHINE LEARNING			CREDITS	3
Course Code	ECB4705	Course Category		L-T-P-S	3-0-0-0
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	To understand the concepts of Machine Learning	
2	To understand supervised learning and apply neural networks in various applications	
3.	To explain the concepts and algorithms of unsupervised learning	
4	To apply the theoretical and practical aspects of Probabilistic Graphical Models.	
5	To explain the concepts and algorithms of advanced learning	

Prerequisites:

MODULE 1 – INTRODUCTION (9)

Machine Learning–Types of Machine Learning –Machine Learning process-preliminaries, testing Machine Learning algorithms, turning data into Probabilities, and Statistics for Machine Learning-Probability theory –Probability Distributions –Decision Theory.

MODULE 2 – SUPERVISED LEARNING (9)

Linear Models for Regression –Linear Models for Classification-Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models –Decision Tree Learning –Bayesian Learning, Naïve Bayes –Ensemble Methods, Bagging, Boosting, Neural Networks, Multi-layer Perceptron, Feed-forward Network, Error Back propagation -Support Vector Machines.

MODULE 3 – UNSUPERVISED & ADVANCED LEARNING (9)

. Clustering-K-means –EM Algorithm-Mixtures of Gaussians –Dimensionality Reduction,Linear Discriminant Analysis, Factor Analysis, Principal Components Analysis, Independent Components Analysis. Sampling-Basic Sampling methods, Monte Carlo, Gibbs Sampling –Computational Learning Theory –Mistake Bound Analysis –Reinforcement learning –Markov Decision processes, Deterministic and Non-deterministic Rewards and Actions, Temporal Difference Learning Exploration.

MODULE 4 – PROBABILISTIC GRAPHICAL MODELS (9)

Graphical Models –Undirected Graphical Models –Markov Random Fields –Directed Graphical Models –Bayesian Networks –Conditional Independence properties –MarkovRandom Fields-Hidden Markov Models –Conditional Random Fields(CRFs).

MODULE 5 - MACHINE LEARNING IN IMAGE PROCESSING	
Image content Analysis- Feature mapping using the scale-invariant feature transform (SIFT) algorithm- Image classification using Convolutional Neural Networks (CNNs)-Image registration using the random sample consensus (RANSAC) algorithm-Morphological processing	
TEXT BOOKS	
1.	Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2007.
2.	Stephen Marsland, "Machine Learning –An Algorithmic Perspective", Chapman andHall, CRC Press, Second Edition, 2014.
REFERENCE BOOKS	
1	Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
2	EthemAlpaydin, "Introduction to Machine Learning", MIT Press, Third Edition, 2014.
3	Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
E BOOKS	
1	https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html
2	https://drive.google.com/file/d/1tYo_xIAi8jPqKiaHSPQX9pHaJ8tf8MTd/view
MOOC	
1	https://www.coursera.org/learn/machine-learning
2	http://www.cs.cmu.edu/~tom/10701_sp11/

COURSE TITLE	VIDEO PROCESSING			CREDITS	3
Course Code	ECA4725	Course Category		L-T-P-S	3-0-0-0
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	Recall the basics of Video representations and their characteristics.	
2	Outline the Motion estimation techniques and Compare them	
3.	Explain the functions of various Video coding schemes	
4	Examine the characteristics of Error control mechanisms of Video communication	
5	Explain the streaming video concepts over the internet	

Prerequisites:

MODULE 1 – INTRODUCTION TO VIDEO PROCESSING

Principles of colour video processing, Video display, Composite versus component video, Progressive and interlaced scan, Sampling and Interpolation of video signals.

MODULE 2 – MOTION DETECTION AND ESTIMATION

General methodologies- Pixel based motion estimation-Block matching algorithm- Mesh based motion estimation- Global motion estimation- Region based motion estimation- Multi - resolution motion estimation- Direct motion Estimation

MODULE 3 – VIDEO CODING TECHNIQUES

Basic Video coding techniques- Wave form based coding, Block-based transform coding, Predictive coding, temporal prediction and transform coding Content based Video coding techniques- Region based video coding, Object based coding, Knowledge based coding, Semantic coding and layered coding system Application of motion estimator in video coding

MODULE 4 – ERROR CONTROL IN VIDEO COMMUNICATIONS

Overview of approaches- Video applications and communication networks- Transport level error control- Error resilient encoding- Encoder-decoder interactive error control- Error resilience Tools in H.263 and MPEG-4

MODULE 5 – STREAMING VIDEO OVER THE INTERNET

Overview of video streaming systems- Video compression- Application layer QoS control for streaming video- Continuous media Distribution services- Streaming servers- Media

synchronizationProtocols for streaming video	
REFERENCE BOOKS	
1	Yao Wang, Jorn Ostermann, Ya-Qin Zhang, Video Processing and Communications‘,Prentice Hall,2002 2. 3. 45.
2	Alan C.Bovik, _The Essential Guide to Video Processing‘,Elsevier Science, edition 2, 2009
3	A. Murat Tekalp, _Digital Video Processing‘,Prentice Hall, edition 1, 1996
4	Jens R. Ohm, _Multimedia Communication Technology: Representation, Transmission and Identification of Multimedia Signals ,Springer, 2004
5	M.E.Al-Mualla, C. N. Canagarajah and D. R.Bull, ―Video Coding for Mobile
MOOC	
1	https://nptel.ac.in/courses/117/104/117104020/

COURSE TITLE	ADVANCED DIGITAL SIGNAL PROCESSING			CREDITS	3
Course Code	ECA4726	Course Category	DE	L-T-P-S	3-0-0-0
CIA				ESE	
LEARNING LEVEL	BTL-3			ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
	On completion of this course the students will be able to	
1.	Analyze various mathematical descriptions and modeling of discrete time random signals	1,2,3,4
2.	Analyse different estimation techniques for both linear and spectrum	1,2,3,4
3.	Design adaptive filters for a given application and to design multi- rate DSP systems	1,2,3,4,9,10
4.	Familiarize with estimation, prediction and filtering concepts and techniques	1,2,3,4
5.	Explain the various types of processors and programming concepts.	1,2,3,4,6

Pre requisites:Z transform, basic DSP processor, FIR filter, IIR filter

MODULE 1 – DISCRETE RANDOM SIGNAL PROCESSING

Wide sense stationary process – Ergodic process – Mean – Variance - Auto-correlation and Autocorrelation matrix - Properties - Weiner Khitchine relation - Power spectral density – filtering random process, Spectral Factorization Theorem–Simulation of uniformly distributed/Gaussian distributed white noise – Simulation of Sine wave mixed with Additive White Gaussian Noise.

MODULE 2 – SPECTRUM AND LINEAR ESTIMATION

Non-parametric methods correlation method, co-variance estimator, performance analysis of estimators, consistent estimators, AR,MA, ARMA signal modeling parameter estimation using Yule-walker method. Maximum likelihood criterion efficiency of estimator, least mean squared error criterion, recursive estimators, and linear predications.

MODULE 3 – ADAPTIVE FILTERS

Applications of Adaptive Filters, Adaptive Direct Form FIR Filters: The LMS Algorithm, Adaptive Lattice Ladder Filters, Recursive Least Squares, Lattice and Ladder Algorithms.

MODULE 4 – DSP CHIPS	
Introduction to fixed point and floating point processors, ADSP21xx and TMS320Cxx-Architecture, Memory, Addressing Modes, Interrupts, Applications. Comparison of ADSP21xx and TMS320Cxx series.	
MODULE 5 – MULTIRATE DIGITAL SIGNAL PROCESSING	
Mathematical description of change of sampling rate - Interpolation and Decimation - Continuous time model - Direct digital domain approach - Decimation by integer factor - Interpolation by an integer factor - Single and multistage realization - Poly phase realization - Applications to sub band coding - Wavelet transform and filter bank implementation of wavelet expansion of signals.	
TEXT BOOKS	
1.	Dag Stranneby, William Walker, "Digital Signal Processors and applications", lsevier, 2003.
2.	Robert Oshana, "DSP Software Development Techniques for embedded real time applications", Elsevier, 2006.
3	Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, 2006
REFERENCE BOOKS	
1 Emmanuel C.Ifeachor Barrie W.Jervis, 'Digital Signal Processing', Pearson Education Asia 2. Proakis, Manolakis, 'Digital Signal Processing principles, algorithms, and applications', Prentice Hall India. 3. S.K.Mitra ,'Digital Signal Processing', Tata-Mcgraw Hill. ADSP 2181 manuals 4. Keshab K. Parhi, 'VLSI DSP Systems; Design & implementation,, Wiley Interscience Publishers. 5. John G. Proakis, Charles M. Rader, Fuyun Ling, Chrysostomos L. Nikias, Marc Moonen, Ian k Proudler, 'Algorithms for statistical signal processing', Pearson Education Asia.	
E BOOKS	
1	DimitrisManolakis, VinayIngle, Stephen Kogon, 'Statistical and Adaptive Signal Processing',Springer publication.
2	Widrow, 'Adaptive signal processing', Pearson Education India, 1985
MOOC	
1	https://nptel.ac.in/courses/117101001/

COURSE TITLE	COMPUTER VISION			CREDITS	3
Course Code	ECA4727	Course Category		L-T-P-S	3-0-0-0
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	Explain various recognition methodologies.	1,2,5,6
2	Describe the binary machine vision techniques.	1,2,5,6
3.	Apply mathematical concepts for area extraction.	1,2,5,6
4.	Elaborate the techniques to recognize various objects and image matching.	1,2,5,6
5.	Describe the frameworks for matching and knowledge representation.	1,2,5,6

Prerequisites:

MODULE 1 – RECOGNITION METHODOLOGY

Recognition Methodology: Conditioning, Labeling, Grouping, Extracting, and Matching. Edge detection, Gradient based operators, Morphological operators, Spatial operators for edge detection. Thinning, Region growing, region shrinking, Labeling of connected components

MODULE 2 – BINARY MACHINE VISION

Binary Machine Vision: Thresholding, Segmentation, Connected component labelling, Hierarchal segmentation, Spatial clustering, Split & merge, Rule based Segmentation, Motion based segmentation.

MODULE 3 – BINARY AREA EXTRACTION AND REGION ANALYSIS

Area Extraction: Concepts, Data structures, Edge, Line Linking, Line detector - Hough transform, Line fitting, Curve fitting (Least square fitting). Region Analysis: Region properties, External points, Spatial moments, Mixed spatial gray level moments, Boundary analysis: Signature properties, Shape numbers. Edges – Canny, LOG, DOG.

MODULE 4 – OBJECT MODEL RECOGNITION AND MATCHING

Facet Model Recognition: Labeling lines, Understanding line drawings, Classification of shapes by labeling of edges, Recognition of shapes, consisting labeling problem, Back tracking, Perspective Projective geometry, Inverse perspective Projection, Photogrammetry. From 2D to 3D, Image matching: Intensity matching of ID signals, Matching of 2D image, Hierarchical image matching - Object Models and Matching: 2D representation, Global vs. Local features

MODULE 5 – GENERAL FRAMEWORKS AND KNOWLEDGE BASED VISION

General Frame Works For Matching: Distance relational approach, Ordered structural matching, View class matching, Models database organization. General Frame Works: Distance .relational approach, Ordered .Structural matching, View class matching, Models database organization. Knowledge Based

Vision: Knowledge representation, Control-strategies, Information Integration. Histogram based Image Processing.	
TEXT BOOKS	
1.	David A. Forsyth, Jean Ponce, “Computer Vision: A Modern Approach”, Prentice Hall, 2011.
2.	Wesley E. Snyder and Hairong Qui, “Fundamentals of Computer Vision”, Cambridge University Press, 2017.
	REFERENCE BOOKS
1	Rajalingappaa Shanmugamani, “Deep Learning for Computer Vision: Expert techniques to train advanced neural networks using TensorFlow and Keras”, Packt Publishing Limited, 2017
2	Alexander Hornberg, “Handbook of Machine and Computer Vision: The Guide for Developers and Users”, Wiley Publications, 2017.
3	Gustavo Olague, “Evolutionary Computer Vision: The First Footprints (Natural Computing Series)”, Springer, Amazon Asia-Pacific Holdings Private Limited, 2016
E BOOKS	
1.	http://freecomputerbooks.com/Computer-Vision-Xiong-Zhihui.html
MOOC	
1.	https://in.udacity.com/course/introduction-to-computer-vision--ud810
2.	https://onlinecourses.nptel.ac.in/noc18_ee08
3.	https://www.edx.org/course/computer-vision-and-image-analysis

SEMESTER – II

COURSE TITLE	MULTIMEDIA COMPRESSION TECHNIQUES			CREDITS	3
Course Code	ECA4703	Course Category	PC	L-T-P-S	3-0-0-0
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	Design an application with error–control.	1,2,9
2	Use compression and decompression techniques.	1,2,3
3.	Apply the concepts of multimedia communication. Concentrate different IP technology Study related to multimedia networking	1,2,3

Prerequisites:

MODULE 1 – MULTIMEDIA COMPONENTS

Introduction – Multimedia skills – Multimedia components and their characteristics – Text, sound, images, graphics, animation, video, hardware.

MODULE 2 – AUDIO AND VIDEO COMPRESSION

Audio compression–DPCM-Adaptive PCM –adaptive predictive coding-linear Predictive coding-code excited LPC-perpetual coding Video compression –principles-H.261-H.263-MPEG 1, 2, and 4.

MODULE 3 – TEXT AND IMAGE COMPRESSION

Compression principles-source encoders and destination encoders-lossless and lossy compression-entropy encoding –source encoding -text compression – static Huffman coding dynamic coding –arithmetic coding –Lempel Ziv-Welsh Compression-image compression.

MODULE 4 – VOIP TECHNOLOGY

Basics of IP transport, VoIP challenges, H.323/ SIP –Network Architecture, Protocols, Call establishment and release, VoIP and SS7, Quality of Service- CODEC Methods- VOIP applicability.

MODULE 5 – MULTIMEDIA NETWORKING

Multimedia networking -Applications-streamed stored and audio-making the best Effort service-protocols for real time interactive Applications-distributing multimedia-beyond best effort service-secluding and policing Mechanisms-integrated services-differentiated Services-RSVP.

TEXT BOOKS

1. Fred Halshall,’Multimedia Communication-Applications,Networks, Protocols and

	Standards', Pearson Education, 2007.
2.	Tay Vaughan, 'Multimedia: Making it Work', 7th Edition, TMH 2008 98.
3.	Kurose and W. Ross, 'Computer Networking a Top down Approach', Pearson Education 2005.
	REFERENCE BOOKS
1	Marcus Goncalves,'Voice over IP Networks', McGraw Hill, 1999.
2	KR. Rao,Z S Bojkovic, D A Milovanovic, 'Multimedia Communication Systems: Techniques, Standards, and Networks', Pearson Education, 2007.
3	R. Steimnetz, K. Nahrstedt, 'Multimedia Computing, Communications and Applications', Pearson Education, Ranjan Parekh, 'Principles of Multimedia', TMH 2007.
4	Khalid Sayood : Introduction to Data Compression, Morgan Kauffman Harcourt India, 2nd Edition, 2000.
E BOOKS	
	http://freevideolectures.com/Course/2320/Digital-Voice-and-Picture-Communication/31
	Khalid sayood,'introduction to data compression', Elsevier publishers, third edition
MOOC	
1	https://nptel.ac.in/downloads/117105083/#
2	https://nptel.ac.in/syllabus/117105083/

COURSE TITLE	IMAGE PROCESSING APPLICATIONS			CREDITS	3
Course Code	ECA4704	Course Category	PC	L-T-P-S	3-0-0-0
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	Utilize the concepts of image processing in biometric applications	1,2,3
2	Make use of image analysis conceptions to various medical image applications	1,2,3
3.	Apply and examine the concepts of image processing to satellite and remote sensing applications.	1,2,3
4	Identify and analyze the applications of image processing in various domains of industry	1,2,3
5.	Illustrate the applications of video processing with examples	1,2,3

Prerequisites:

MODULE 1 – REMOTE SENSING & MONITORING APPLICATIONS

Introduction- Biometric Pattern Recognition- Face Recognition –Feature Extraction-Selection-Face Identification -Signature Verification-Preprocessing of Signature Patterns

MODULE 2 – MEDICAL IMAGE APPLICATIONS

Lung Disease Identification-Heart Disease Identification- Bone Disease Identification-Dental X-Ray Image Analysis- Classification of Dental Caries- Mammogram Image Analysis-Pelvic Image Analysis

MODULE 3 – SATELLITE AND REMOTE SENSING APPLICATIONS

Introduction-Satellite sensors and imageries- Features of Multispectral Images- Spectral reflectance of various earth objects-Water Regions-Vegetation Regions-Soil- Man-made/Artificial Objects-Scene Classification Strategies-Neural Network-Based Classifier Using Error Backpropagation- Counterpropagation network

MODULE 4 – INDUSTRIAL APPLICATIONS

Food Industry-Automotive Industry-Textile Industry-Agriculture Industry-Robotics

MODULE 5 – VIDEO PROCESSING APPLICATIONS

Pixel-based model- Shadow Detection-Surveillance system- Region-based model- Principles of object tracking-Case Study. Geometrical model- Video restoration –Case Study

TEXT BOOKS

1.	Tinku Acharya and Ajoy K. Ray-Image Processing Principles and Applications, A John Wiley & Sons, Mc., Publication 2005.
2.	Gonzalez & Woods ―Digital Image Processing, 3rd ed., Pearson educaon, 2008
3.	Ardeshir Goshtasby, " 2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications",John Wiley and Sons,2005.
	REFERENCE BOOKS
1.	S. Sridhar - Digital Image Processing, 2nd ed., Oxford University Press, 2016.
2.	Chanda Dutta Magundar – Digital Image Processing and Analysis, Prentice Hall of India, 2000.
E BOOKS	
1.	I.Pitas-Digital Image Processing Algorithms and Applications, John Wiley & Sons, Mc., Publication 2000.
2.	John R.Jensen-Introductory Digital Image Processing –A Remote Sensing Prespective, (Pearson Series in Geographic Information Science) 4th Edition, Kindle Edition.
MOOC	
1.	https://swayam.gov.in/nd1_noc19_ee55/preview
2.	https://nptel.ac.in/courses/117/105/117105079/

COURSE TITLE	MEDICAL IMAGING TECHNIQUES			CREDITS	3
Course Code	ECA4705	Course Category		L-T-P-S	3-0-0-0
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	Summarize the Production of X-rays and its applications to different medical Imaging techniques	1,2,4,8,11
2	Use different types of Radio diagnostic techniques	1,2,4,8,11
3.	Apply the special imaging techniques used for visualizing the cross sections of the body	1,2,4,8,11
4.	Analyze the imaging of soft tissues using ultrasound and MRI techniques	1,2,4,8,11

Prerequisites:

MODULE 1 – PRINCIPLES OF RADIOGRAPHIC EQUIPMENT

X-Ray tubes, cooling systems, removal of scatters, Fluoroscopy- construction of image Intensifier tubes, angiographic setup, mammography, digital radiology, DSA.

MODULE 2 – COMPUTED TOMOGRAPHY

Need for sectional images, Principles of sectional scanning, CT detectors, Methods of reconstruction, Iterative, Back projection, convolution and Back-Projection. Artifacts, Principle of 3D imaging

MODULE 3 – RADIO ISOTOPIC IMAGING

Alpha, Beta and Gamma radiation, Radiation detectors, Radio isotopic imaging equipments, Radio nuclides for imaging, Gamma ray camera, scanners, Positron Emission tomography, SPECT,PET/CT.

MODULE 4 – ULTRASONIC SYSTEMS

Wave propagation and interaction in Biological tissues, Acoustic radiation fields, continuous and pulsed excitation, Transducers and imaging systems, Scanning methods, Imaging Modes, Principles and theory of image generation.

MODULE 5 – MAGNETIC RESONANCE IMAGING

NMR, Principles of MRI, Relaxation processes and their measurements, Pulse sequencing and MR image acquisition, MRI Instrumentation, Functional MRI.

TEXT BOOKS

1.	Peggy, W., Roger D.Ferimarch, MRI for Technologists, Mc Graw Hill, New York, 1995.
2.	Steve Webb, The Physics of Medical Imaging, Taylor & Francis group, CRC Press, 2nd edition, 2012.
3.	Kurose and W. Ross, 'Computer Networking a Top down Approach', Pearson Education 2005.

	REFERENCE BOOKS
1	D.N.Chesney and M.O.Chesney Radio graphic imaging, CBS Publications, New Delhi, 1987.
2	Donald W.McRobbice, Elizabeth A.Moore, Martin J.Grave and Martin R.Prince MRI from picture to proton ,Cambridge University press, New York 2006.
3	Jerry L.Prince and JnathanM.Links, Medical Imaging Signals and Systems- Pearson Education Inc. 2006.
E BOOKS	
1.	https://www.springer.com/gp/book/9783319965192
2.	https://noeniar.ga/file-ready/medical-imaging-systems
MOOC	
1.	https://nptel.ac.in/courses/108/105/108105091/

COURSE TITLE	IMAGE PROCESSING LAB - II			CREDITS	2
Course Code	ECA4792	Course Category		L-T-P-S	
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	Analyze techniques such as image denoising, image segmentation and edge detection.	1,2,3,5
2	Apply spatial and frequency domain filters on an image.	1,2,3,5
3.	Analyze the effects of image transforms.	1,2,3

Prerequisites:

LIST OF EXPERIMENTS

1. Program to enhance an image using image arithmetic and logical operations
2. Image enhancement using python programming.
3. Gray level slicing with and without background.
4. Image sharpen an image using 2-D laplacian high pass filter in spatial domain.
5. Smooth an image using low pass filter in frequency domain.
6. Sharpen an image using high pass filter in frequency domain
7. Image Segmentation
8. Program for illustrating color image processing Wavelet based Image Processing
9. Object Recognition and Neural Network Simulation.
10. Apply 2 D DFT, DCT and DWT transform for an image and compare the results
11. Feature extraction and classification for medical image
12. Implement an Image Classifier using CNN in TensorFlow/Keras.

TEXT BOOKS

1.	Rafael C. Gonzalez, Richard Eugene Woods, Steven L. Eddins, Digital Image Processing Using MATLAB, Pearson Education India, 2004.

REFERENCE BOOKS

1	Jayaraman S, Veerakumar T, Esakkirajan S, Digital Image Processing", Mc Graw Hill Education, 2009.
2	Chris Soloman, Toby Breckon, Fundamentals of Digital Image Processing: A Practical Approach with examples in Matlab", Wiley-Blackwell, 2010

E BOOKS

1	https://www.intechopen.com/books/applications-from-engineering-with-matlab-concepts/digital-image-processing-with-matlab

COURSE TITLE	MINIPROJECT			CREDITS	2
Course Code	ECA4781	Course Category		L-T-P-S	
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	To develop an aptitude for research and independent learning	
2	To demonstrate the ability to apply the acquired knowledge in practical applications	
3.	To use new tools and techniques for the design and development.	

DEPARTMENT ELECTIVE –III

COURSE TITLE	BRAIN COMPUTER INTERFACE			CREDITS	3
Course Code	ECA4728	Course Category		L-T-P-S	3-0-0-3
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	To acquire the brain signal in the format required for the specific application	
2.	To preprocessing the signal for signal enhancement	
3.	To extract the dominant and required features	
4.	Classify and derive the control signals for BCI applications	
5.	To apply the BCI knowledge for medical applications	

MODULE 1 – INTRODUCTION TO BCI (9)

Fundamentals of BCI –Structure of BCI system –Classification of BCI: Invasive, Non-invasive and Partially invasive BCI-Brain signal acquisition, Signal Preprocessing, Artifacts removal

MODULE 2 – ELECTROPHYSIOLOGICALSOURCES (9)

Sensorimotor activity –Neuronal activity in motor cortex and related areas-Electric and magnetic fields produced by the brain-signals reflecting brain metabolic activity-Mu rhythm, Movement Related Potentials –Slow Cortical Potentials -P300 Event related potential -Visual Evoked Potential -Activity of Neural Cells -Multiple Neuro mechanismsUN

MODULE 3 – FEATURE EXTRACTION METHODS (9)

Time/Space Methods –Fourier Transform, Wavelets, AR, MA,ARMA models, Bandpass filtering, Template matching, Kalman filter, PCA, Laplacian filter –Linear and Non-LinearFeatures

MODULE 4 – FEATURE TRANSLATION METHODS (9)

Linear DiscriminantAnalysis –Nearest neighbours, Support Vector Machines -Regression –Learning Vector Quantization –Gaussian Mixture Modeling –Hidden Markov Modeling –Neural Networks

MODULE 5 – APPLICATIONS OF BCI (9)

Study of BCI Competition III –Dataset I, II,III, IV and V, Functional restoration using Neuroprosthesis -Functional Electrical Stimulation, Visual Feedback and control -External device controllers, Case study: Brain actuated control of mobile Robot. Ethical issues in BCI research

TEXT BOOKS

1. JonaanWolpaw, ElizabethWinterWolpaw, BrainComputerInterfaces: Principles and practice, Edition 1, Oxford University Press, USA, January 2012
2. Andrew Webb, Statistical Pattern Recognition,Wiley International, Second Edition, 2002.

REFERENCES	
1.	Jose del R.Millan et al, Non-invasive brain actuated control of a mobile robot by human EEG, IEEE Transactions on biomedical Engineering, Vol 51, No.6, 2004 June
2.	S.Coyle, T.Ward et al, On the suitability of near infra-red systems for next generation Brain Computer interfaces, Physiological Measurement, 25, 2004
3.	BernhardGraimann,BrendanAllison, GertPfurtscheller, Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010

COURSE TITLE	CRYPTOGRAPHY				CREDITS	3
Course Code	ECA4729	Course Category		L-T-P-S	3-0-0-0	
CIA				ESE		
LEARNING LEVEL				ASSESSMENT MODEL		

	COURSE OUTCOMES	PO
1.	Recognize and explain aspects of number theory which are relevant to cryptography	1,2,3,6
2.	Explain various cipher models	1,2,3
3.	Compare different security notions for private- and public-key encryption	1,2,3
4.	Combine number theory and cryptography	1,2,3
5.	Describe the principles of public key cryptosystems, hash functions and digital signature	1,2,3

Prerequisites:

MODULE 1 – Number Theory and Finite Fields

Number Theory and Finite Fields: Divisibility and the divisibility algorithm, Euclidean algorithm, Modular arithmetic, Groups, Rings and Fields, Finite fields of the form GF(p), Polynomial arithmetic, Finite fields of the form GF(2n)

MODULE 2 – Classical Encryption Techniques

Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques, Steganography

SYMMETRIC CIPHERS: Traditional Block Cipher structure, Data Encryption Standard (DES)

MODULE 3 – SYMMETRIC CIPHERS

SYMMETRIC CIPHERS: The AES Cipher

Pseudo-Random-Sequence Generators and Stream Ciphers: Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs

MODULE 4 – More number theory

More number theory: Prime Numbers, Fermat's and Euler's theorem, Primality testing, Chinese Remainder theorem, discrete logarithm.

Principles of Public-Key Cryptosystems: The RSA algorithm, Diffie - Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography

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MODULE 5 – One-Way Hash Functions	
One-Way Hash Functions: Background, Snefru, N-Hash, MD4, MD5, Secure Hash Algorithm [SHA],One way hash functions using symmetric block algorithms, Using public key algorithms, Choosing a one-way hash functions, Message Authentication Codes. Digital Signature Algorithm, Discrete Logarithm Signature Scheme	
TEXT BOOKS	
1.	William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education, March 2013.
2.	Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill, 2007
	REFERENCE BOOKS
1	Man Young Rhee, "Internet Security: Cryptographic Principles", "Algorithms and Protocols", Wiley Publications, 2003.
2	Bruce Schneier and Neils Ferguson, "Practical Cryptography", First Edition, Wiley Dreamtech India Pvt Ltd, 2003.
3	Douglas R Simson "Cryptography – Theory and practice", First Edition, CRC Press, 1995
E BOOKS	
1	http://www.freebookcentre.net/Security/Free-Cryptography-Books-Download.html
2	https://crypto.stanford.edu/~dabo/cryptobook/draft_0_2.pdf
MOOC	
1	https://nptel.ac.in/courses/106/105/106105162/
2	https://nptel.ac.in/courses/106/107/106107155/

COURSE TITLE	VISUALIZATION TECHNIQUES				CREDITS	3
Course Code	ECA4730	Course Category	DE	L-T-P-S	3-0-0-0	
CIA				ESE		
LEARNING LEVEL				ASSESSMENT MODEL		

	COURSE OUTCOMES	PO
1.	To understand the fundamentals of data visualization	
2	To acquire knowledge about the issues in data representation	
3	To visualize the complex engineering design.	
4	To design real time interactive information visualization system.	
5	To apply the visualization techniques in practical applications	

Prerequisites:NIL

MODULE 1 – INTRODUCTION 9

Introduction –Visualization Stages –Computational Support –Issues –Different Types of Tasks –Data representation –Limitation: Display Space, Rendering Time, Navigation Link.

MODULE 2- DATA REPRESENTATION 9

Human Factors –Foundation for a Science of Data Visualization –Environment-Optics – Optimal Display –Overview about Lightness, Brightness, Contrast, Constancy, Color –Visual Attention that Pops Out –Types of Data –Data Complexity –The Encoding of Values – Encoding of Relation –Relation and Connection –Alternative Canvass.

MODULE 3- DATA PRESENTATION 9

Human Vision –Space Limitation –Time Limitations –Design –Exploration of Complex Information Space –Figure Caption in Visual Interface –Visual Objects and Data Objects – Space Perception and Data in Space –Images, Narrative and Gestures for Explanation.

MODULE 4- INTERACTION AND DESIGN 9

Norman's Action Cycle –Interacting with Visualization –Interaction for Information Visualization –Interaction for Navigation –Interaction with Models –Interacting with Visualization –Interactive 3D Illustrations with Images and Text –Personal View –Attitude – user perspective –Convergence –Sketching –Evaluation.

MODULE 5- CURRENT TRENDS 9

Design –Virtual Reality: Interactive Medical Application –Tactile Maps for visually challenged People –Animation Design for Simulation –Integrating Spatial and Nonspatial Data –Innovating the Interaction –Small Interactive Calendars –Selecting One from Many– Web Browsing Through a Key Hole –Communication Analysis –Archival Galaxies.

TEXT BOOKS

1. Robert Spence, "Information Visualization:An Introduction", Third Edition, Pearson Education, 2014.

2.	Colin Ware, “Information Visualization Perception for Design”, ThirdEdition, Morgan Kaufmann, 2012.
3	Robert Spence, “Information Visualization Design for Interaction”, Second Edition, Pearson Education, 2006
	REFERENCE BOOKS
1	Benjamin B. Bederson, Ben shneiderman, “The Craft of Information Visualization”, Morgan Kaufmann, 2003.
2	Thomas Strothotte, “Computational Visualization: Graphics, Abstraction and Interactivity”, Springer, 1998.
3	Matthew O.Ward, George Grinstein, Daniel Keim, “Interactive Data Visualization: Foundation, Techniques and Applications”, Second Edition, A.K.Peters/CRC Press,2015.
4	JoergOsarek, “Virtual Reality Analytics”, Gordon’s Arcade, 2016.

COURSE TITLE	DEEP LEARNING				CREDITS	3
Course Code	ECA4731	Course Category		L-T-P-S	3-0-0-0	
CIA				ESE		
LEARNING LEVEL				ASSESSMENT MODEL		

	COURSE OUTCOMES	PO
1.	To understand the basic ideas and principles of Neural Networks	
2	To do survey of Deep Learning Development Frameworks	
3.	To solve problems in image classification performances using Tensorflow and Keras	
4.	To understand and implement Deep Learning Architectures	
5.	To apply Deep Learning in various applications	

Prerequisites:

MODULE 1 –BASICS OF NEURAL NETWORKS **9**

Basic concept of Neurons –Perceptron Algorithm –Feed Forward and Back Propagation Networks

MODULE 2 – INTRODUCTION TO DEEP LEARNING **9**

Feed Forward Neural Networks –Gradient Descent –Back Propagation Algorithm –Vanishing Gradient problem –Mitigation –RelU Heuristics for Avoiding Bad Local Minima –Heuristics for Faster Training –Nestors Accelerated Gradient Descent –Regularization –Dropout.

MODULE 3 – CONVOLUTIONAL NEURAL NETWORKS **9**

CNN Architectures –Convolution –Pooling Layers –Transfer Learning –Image Classification using Transfer Learning

MODULE 4 – MORE DEEP LEARNING ARCHITECTURES **9**

STM, GRU, Encoder/Decoder Architectures –Autoencoders –Standard-Sparse –Denoising –Contractive-Variational Autoencoders –Adversarial Generative Networks –Autoencoder and DBM

MODULE 5 – APPLICATIONS OF DEEP LEARNING **9**

Image Segmentation –Object Detection –Automatic Image Captioning –Image generation with Generative Adversarial Networks –Video to Text with LSTM Models –Attention Models

for Computer Vision –Case Study: Named Entity Recognition –Opinion Mining using Recurrent Neural Networks –Parsing and Sentiment Analysis using Recursive Neural Networks –Sentence Classification using Convolutional Neural Networks –Dialogue Generation with LSTMs.	
TEXT BOOKS	
1.	Ian Good Fellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017
2.	Ragav Venkatesan, Baoxin Li, "Convolutional Neural Networks in Visual Computing", CRC Press, 2018.
3.	Navin Kumar Manaswi, "Deep Learning with Applications Using Python", Apress, 2018.
	REFERENCE BOOKS
1	Francois Chollet, "Deep Learning with Python", Manning Publications, 2018.
2	.Phil Kim, "Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence", Apress , 2017
3	Joshua F. Wiley, "R Deep Learning Essentials", Packt Publications, 2016.
E BOOKS	
1.	http://www.deeplearningbook.org/
2.	http://neuralnetworksanddeeplearning.com/index.html
MOOC	
1	https://www.udacity.com/course/deep-learning-nanodegree--

DEPARTMENT ELCTIVE –IV

COURSE TITLE	BIOSIGNAL PROCESSING			CREDITS	3
Course Code	ECA4732	Course Category		L-T-P-S	3-0-0-3
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	To analyze the different types of signals &systems	
2.	To analyze signals in time series domain & estimate the spectrum	
3.	To demonstrate the significance of wavelet detection applied in bio signal processing.	
4	To perform classification of bio signals.	
5	To extract the features using multivariate component analysis	

MODULE 1 –SIGNAL, SYSTEMANDSPECTRUM (9)

Characteristics of some dynamic biomedical signals, Noises-random, structured and physiological noises. Filters-IIR and FIR filters. Spectrum –power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

MODULE 2 - TIME SERIES ANALYSIS ANDSPECTRALESTIMATION (9)

Time series analysis –linear prediction models, process order estimation, non-stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG and HRV signals, model based ECG simulator. Spectral estimation –Blackman Tukey method, periodogram and model based estimation. Application in Heart rate variability, PCG signals,

MODULE 3 –ADAPTIVE FILTERING ANDWAVELETDETECTION (9)

Filtering –LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in FECG, EEG and other applications in Bio signals, Wavelet detection in ECG–structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

MODULE 4 –BIOSIGNAL CLASSIFICATION AND RECOGNITION (9)

Signal classification and recognition –Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats and other Biomedical applications

MODULE 5 – TIME FREQUENCY ANDMULTIVARIATEANALYSIS (9)

Time frequency representation, spectrogram, Time-scale representation, scalogram, wavelet analysis –Data reduction techniques, ECG data compression, ECG characterization, Feature extraction-Wavelet packets, Multivariate component analysis-PCA, ICA.

TEXT BOOKS

1.	RangarajM.Rangayyan,BiomedicalSignalAnalysis–A casestudyapproach, Wiley,2ndEdition, 2009.
2.	Willis J.Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2006.
REFERENCE BOOKS	
1.	Emmanuel C. Ifeachor, Barrie W.Jervis, Digital Signal processing-A Practical Approach,Pearson education Ltd.,2ndEdition,2002
2.	Raghuveer M. Rao and Ajith S.Bopardikar, Wavelets transform –Introduction to theory and its applications, Pearson Education, India2000.
3.	Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc.,Boca Rato, Florida1999.

COURSE TITLE	ADVANCED COMPUTER GRAPHICS AND ANIMATIONS			CREDITS	3
Course Code	ECA4733	Course Category		L-T-P-S	3-0-0-0
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	To understand the basics of graphics	
2	To perform transforms on geometry processing	
3.	To understand fractals and explain its applications	
4.	To explain graphics algorithm	
5.	To develop programs for advanced animation and to become proficient in graphics programming using OpenGL.	

Prerequisites:

MODULE 1 – FUNDAMENTALS **9**

Basics -Scope and Applications –Graphics Standards –Display Systems –Image Formation – Graphics Systems –2D and 3D Coordinate Systems –Vectors –Matrices and Basic Vector/Matrix Operations –Line Drawing –Object Representation –Anti-Aliasing.

MODULE 2 –TRANSFORMATIONS **9**

2D and 3D Geometric Transformations: Translation, Rotation, Scaling, Affine–Hierarchical Modelling & viewing –The Camera Transformation –Perspective –Orthographic and Stereographic Views.

MODULE 3 – COMPUTER GRAPHICS STANDARDS **9**

Graphical Kernel System (GKS), GKS-3D, Programmer's Hierarchical Interactive Graphics System (PRIGS), Computer Graphics Interface (CGI), and the Computer Graphics Metafile (CGM).

MODULE 4 – ADVANCED GRAPHICS **9**

Hidden Surface Removal–Parametric Curves and Surfaces–Global Illumination –Ray Casting –Monte Carlo Algorithm –Texture Synthesis –Bump Mapping –Environmental Mapping – Advanced Lighting and Shading –Shadows –Volumetric Rendering.

MODULE 5 – ANIMATION **9**

Overview of Animation Techniques –Key framing, Computer Animation –Motion Capture and Editing–Forward/Inverse Kinematics–3D Computer Animation for Applications Such asGames and Virtual Environments –Character Animation Techniques Such as Synthesizing their Body Movements –Facial Expressions and Skin Movements –Behaviors in Crowded Scenes.

TEXT BOOKS	
1.	Donald D. Hearn, M. Pauline Baker, Warren Carithers, “Computer Graphics with Open GL”, Fourth Edition, Prentice Hall, 2011.
2.	Foley van Dam, Feiner Hughes, “Computer Graphics Principles and Practice”, Third Edition, Addison Wesley, 2014.
3.	Alan Watt, Mark Watt, “Advanced Animation and Rendering Techniques: Theory and Practice”, Addison Wesley, 1992.
	REFERENCE BOOKS
1	Rick Parent, “Computer Animation –Algorithms and Techniques”, Third Edition, Morgan Kaufman, 2012.
2	Edward Angel,Dave Shreiner, “Interactive Computer Graphics: A Top-Down Approach with OpenGL”, Sixth Edition, Addison Wesley, 2012
	https://commons.erau.edu/cgi/viewcontent.cgi?article=2243&context=space-congress-proceedings

COURSE TITLE	INTERNET OF THINGS : FOUNDATIONS AND PRACTICES			CREDITS	3
Course Code	ECA4734	Course Category		L-T-P-S	3-0-0-1
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	COURSE OUTCOMES	PO
1.	Understand the IoT enabling technologies	1,2
2.	Design IoT devices with specifications	1,2,3,4,9
3.	Discuss the challenges in designing IoT projects,	9,10
4.	Analyze the various network management models and their performance.	1,2,4
5.	Know how the IoT is application oriented	1,2,3,10,11,12

Prerequisites:

MODULE 1 – INTRODUCTION AND ENABLING TECHNOLOGIES (9)

Introduction to the internet of things. IoT Architecture: History of IoT, M2M – Machine to Machine, Web of Things, IoTprotocols : the Architecture , Layering concepts, IoT Communication Pattern, IoT protocol Architecture, The 6LoWPAN, IoT Enabling Technologies, Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT levels

MODULE 2 – IoT and M2M (9)

Introduction to M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software Defined Networking, Network Function Virtualization, IoT Platform Design Methodology, IoT Design Methodology, Purpose and requirement specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specification, IoT Level Specification, Function View Specification, Operational View Specification, Device and Component Integration

MODULE 3 –IoT & IMAGE PROCESSING (9)

IoT & image processing in smart agriculture –IoT based home security through image processing algorithms-Application of multisensory image fusion of IoT in image processing- IoT-Based Image Recognition System for Smart Home-Delivered Meal Services

MODULE 4 - IOT PHYSICAL DEVICES, ENDPOINTS AND PROJECTS (9)

What is an IOT Device, Exemplary Device, Board, Linux on Raspberry Pi, Interfaces and programming IOT Devices. Creating the sensor project -Preparing Raspberry Pi , Clayster libraries, Interfacing the hardware, Internal representation of sensor values, Persisting data, External representation of sensor values, Exporting sensor data, Creating a controller - Representing sensor values, Parsing sensor data, Calculating control states

MODULE 5 – OPENCV& RASPBERRY PI (9)

Introduction to Open CV& Raspberry Pi – Application of Open CV& Raspberry Pi in image processing- Deep learning object detection with OpenCV- Raspberry Pi for

computer vision

TEXT BOOKS

1. ArshdeepBahga, Vijay Madisetti, “Internet Of Things-A Hands on Approach”, Universities Press, 2014.

REFERENCE BOOKS

1. Adrian McEwen& Hakim Cassimally, “Designing the Internet of Things”, Wiley Publishers, 2013
2. Byron Henderson and Francis DaCosta “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything” APress; 1st edition , 2014.
3. Peter wahar “Learning Internet of Things” Packt publishing limited, 2015. (Unit IV)
4. Phillippa Biggs “Harnessing the Internet of Things for Global Development” CISCO article

COURSE TITLE	RETINAL IMAGE ANALYSIS				CREDITS	3
Course Code	ECA4735	Course Category		L-T-P-S	3-0-0-0	
CIA				ESE		
LEARNING LEVEL	BTL-5			ASSESSMENT MODEL		

MODULE 1 – INTRODUCTION TO RETINA (9)

Introduction, History of Retina, Structure, inverted versus non-inverted retina, Retinal layers, Development, Blood supply, Functions of Retina, Clinical significance.

MODULE 2 – INTRODUCTION TO DIGITAL IMAGE CAPTURE (9)

General, Principle of Digital Image Capture, Processing and Analysis, Image Capture, Image Processing, Image Enhancement, Image Restoration, Fundus Photography

MODULE 3 – DIABETIC RETINOPATHY AND PUBLIC HEALTH (9)

Introduction, Definition and description, Retinal Structure and its Function, Classification of Diabetic Retinopathy, Systemic Associations of Diabetic Retinopathy, Pathogenesis, Methods of Screening.

MODULE 4 – DISEASES IN THE RETINAL IMAGE ANALYSIS (9)

Retinal Fundus Imaging, Retinal Fundus Imaging, Age-Related Macular Degeneration, Retinal Vascular Occlusions, Blood Vessel Extraction

MODULE 5 – QUEUING RETINAL BLOOD VESSEL SEGMENTATION (9)

Introduction, Enhancement of retinal blood vessels using matched filters, Computation of Gradient Co-occurrence features, Pixel classification using automated entropy thresholding.

TEXT BOOKS

1.	Herbert.F. Jelinek, Michael J CREE, Automated Image Detection of Retinal Pathology, CRC Press, Taylor & Francis Group
2.	Richard S Snell, Michael A lemp, Clinical Anatomy of Eye, Willey Blackwell
3.	A.K. Khurana, Anatomy and Physiology of Eye, Kindle Edition.

COURSE TITLE	INTERNSHIP			CREDITS	2
Course Code	ECA4897	Course Category		L-T-P-S	0-0-0-2
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	OUTCOMES	PO
1.	To get exposure to industry environment	
2	To do mini project	
3.	To apply theoretical knowledge to solve real time problems in induatry	
	• The objective of the internship is to allow the students to go to industry and study the industry environment • The students can spend the vacation period effectively in industry • It provided an opportunity to get placed in the induatry • It helps to do the end semester projects in the industry	

COURSE TITLE	PROJECT PHASE -1			CREDITS	2
Course Code	ECA4898	Course Category		L-T-P-S	0-0-16-8
CIA				ESE	
LEARNING LEVEL				ASSESSMENT MODEL	

	OUTCOMES	PO
1.	To develop an aptitude for research and independent learning	
2	To demonstrate the ability to carry out literature survey and select unresolved problems in the domain of the selected project topic	
3	Gain the expertise to use new tools and techniques for the design and development	
4	To acquire the knowledge and awareness to carry out cost-effective and environment friendly designs	
5	To develop the ability to write good technical report, to make oral presentation of the work, and to publish the work in reputed conferences/journals.	

The project in the third and fourth semesters offer the opportunity to apply and extend knowledge acquired in the first year of the M. Tech. program**.**

The major project can be analytical work, simulation, hardware design or a combination of these in the emerging areas of Image processing, Signal Processing and Communication Engineering under the supervision of a faculty from the ECE Department.

The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. Students will be required to1) perform a literature search to review current knowledge and developments in the chosen technical area; 2) undertake detailed technical work in the chosen area using one or more of the following:•Analytical models•Computer simulations•Hardware implementation.

The emphasis of major project shall be on facilitating student learning in technical, project management and presentation spheres.

Project work will be carried out individually.

The M. Tech. project evaluation committee of the department shall evaluate the project work during the third semester in two phases.

The first evaluation shall be conducted in the middle of the semester. This should be followed by the end semester evaluation. By the time of the first evaluation, students are expected to complete the literature review, have a clear idea of the work to be done, and

	have learnt the analytical / software / hardware tools.

SEMESTER -IV

COURSE TITLE	PROJECT PHASE -1I				CREDITS	2
Course Code	ECA4899	Course Category		L-T-P-S	0-0-24-12	
CIA				ESE		
LEARNING LEVEL				ASSESSMENT MODEL		

	OUTCOMES	PO
1.	To develop an aptitude for research and independent learning	
2	To demonstrate the ability to carry out literature survey and select unresolved problems in the domain of the selected project topic	
3	To apply theoretical knowledge to solve real time problems in the community	
4	To acquire the knowledge and awareness to carry out cost-effective and environment friendly designs	
5	To develop the ability to write good technical report, to make oral presentation of the work, and to publish the work in reputed conferences/journals.	
	Students should complete the work planned in the third semester, attaining all the objectives, and should prepare the project report of the complete work done in the two semesters. They are expected to communicate their innovative ideas and results in reputed conferences and/or journals. The M. Tech. project evaluation committee of the department shall evaluate the project work during the fourth semester.	