ACHARYA NAGARJUNA UNIVERSITY

NAGARJUNA NAGAR, GUNTUR – 522 510
ANDHRAPRADESH, INDIA

CHOICE BASED CREDIT SYSTEM

Regulations, Scheme of Instruction,
Examination and Detailed Syllabi
for

DIGITAL IMAGE PROCESSING

2-Year M.Tech Degree Course
In Computer Science& Engineering
(Semester System)

w.e.f. : 2015-2016

ACHARYANAGARJUNAUNIVERSITY :: NAGARJUNA NAGAR

REVISED REGULATIONS FOR
TWO - YEAR M.TECH. DEGREE COURSE
(CHOICE BASED CREDIT SYSTEM)

(With effect from the batch of students admitted during the academic year 2015-2016)

1.0 ELIGIBILITY FOR ADMISSION

1.1 The candidates, both non-sponsored and sponsored, for Admission into M.Tech programme shall have one of the following qualifications.

S.No.	Programme	Qualifications
1.	Chemical Engineering	Bachelor Degree in Chemical Engineering / Chemical Technology / Biotechnology or its equivalent Degree recognized by AcharyaNagarjunaUniversity
2.	Civil Engineering	Bachelor Degree in Civil Engineering or its equivalent Degree recognized by AcharyaNagarjunaUniversity
3.	Computer Science & Engineering	B.Tech / B.E Computer Science and Engineering / Information Technology / M.C.A / M.Sc., Computers / M.Sc., Electronics / M.Sc., Mathematics or its equivalent Degree recognized by AcharyaNagarjuna University.
4.	Electrical and Electronics Engineering	Bachelor Degree in Electrical &Electronics Engineering / Electrical Engineering / Electrical Power Engineering / AMIE (Electrical Engineering) or its equivalent Degree recognized by AcharyaNagarjuna University.
5.	Electronics and Communication Engineering	Bachelor Degree in Electronics & Communication / Electronic & Instrumentation Engineering / AMIE or its equivalent Degree recognized by AcharyaNagarjunaUniversity.
6.	Mechanical Engineering	Bachelor Degree in Mechanical Engineering or its equivalent Degree recognized by AcharyaNagarjunaUniversity.

1.2 Admission of Non-sponsored category students: Admission of non-sponsored category students is made on the basis of GATE/PGECET rank. When GATE/PGECET qualified candidates are not available, admission will be on the basis of merit in the qualifying examination. Students with or without GATE/PGECET rank should have obtained a minimum of 50% marks in the qualifying examination to become eligible for admission.

Reservation of seats to the candidates belonging to Scheduled Castes and Scheduled Tribes is as prescribed by the State Govt./University from time to time. If suitable candidates are not available to fill all the seats reserved for S.T category, they shall be filled by students S.C. Category and vice-versa.

If suitable candidates are not available for reserved seats, they shall be filled by the general category candidates.

1.3 Admission of Sponsored Category students: Sponsored category students should have at least 50% marks in the qualifying examination to become eligible for admission to the Post Graduate Programme. Preference will be given to those candidates who are GATE/PGECET qualified.

The candidates must have a minimum of two years of full time work experience in a registered firm / company/ industry / educational and research institutions / any government department or government autonomous organizations in the relevant field in which the admission is being sought.

A letter from the employer must be furnished stating that the candidate is being sponsored to get admission. The employer should also indicate that the candidate will not be withdrawn midway till the completion of course. The rule of reservation shall not apply to the admission of sponsored category students.

1.4 The total number of full time candidates admitted into a course with or without GATE/PGECET rank should not exceed the sanctioned strength.

2.0 MEDIUM OF INSTRUCTION, DURATION AND STRUCTURE

2.1. The medium of instruction shall be in English.

2.2. The minimum and maximum period for completion of the P.G. Programme is 4 Semesters for full time students.

2.3. Each Semester shall normally spread over sixteen weeks.

(a) The Programme may consist of
   i. Core Courses
   ii. Elective Courses
   iii. Seminars
   iv. Internship
   v. Project Work

(b) The structure of the Programme comprises of two semesters of course work consisting of 6 Core subjects + 6 Elective subjects and 3 Lab courses + 1 Mini Project / Seminar (or) 2 Lab courses + 2 Seminars / Mini Project, followed by two semesters of Project work. In summer break, the student should undergo internship for four weeks duration. The student should present a seminar on the project work done at the end of the third semester. At the end of fourth semester the students should submit Project Thesis.

(c) Core subjects are fixed in each semester and a student must opt them without any choice. Whereas electives can be chosen by a student from the list of electives given (minimum 18 and maximum 24) according to his choice.

2.4. Project work shall be carried out under the Supervision of a Faculty Member in the concerned department.

2.5. A candidate may, however, in certain cases, be permitted to work on his Project/Dissertation at the place of employment, any recognized Institution/R&D Organization/Industry with the approval of the Head of the Department concerned and Head of the Organization. In such cases, the Project Work shall be jointly supervised by a member of the faculty and a person from the Organization holding a minimum of P.G. Degree in the concerned area of specialization.

2.6. Five copies of the Project Report certified by the Supervisor(s) and the Head of the Department concerned shall be submitted within one Calendar Year after completion of the second semester.

2.7. The student is eligible for the submission of M.Tech. Project Report at the end of fourth semester if he/she passed all the course work in the first & second semesters.

2.8. In a special case, if any candidate unable submit his/her Project Report at the end of fourth semester due to ill health or any other reason permitted by the head of the institution, he/she will be allowed submit at a later date and the viva-voce examination will be conducted, if clause 2.7 is satisfied.

3.0. ATTENDANCE

3.1 The candidate shall put up a minimum of 75% attendance in each subject.

3.2. Condonation of shortage in attendance up to 10% in any subject may be condoned by the University on the recommendations of the Principal of the concerned College for reasons of ill health and the application is submitted at the time of actual illness and is supported by a certificate from the authorized Medical Officer approved by the Principal.

3.3. If the candidate does not satisfy the attendance requirement in any subject he or she shall not be permitted to appear for the University examination in that subject and has to repeat that subject when next offered or study any other specified subject as may be required. In case of repetition the new internal marks will be taken into amount.

3.4. Failure in securing minimum prescribed attendance in any subject of previous Semester (s) is no bar for enrollment to the next semester.

4.0. EVALUATION

4.1 The performance of the candidate in each semester shall be evaluated subject wise. The maximum marks for each subject, seminar etc, will be as prescribed in the curriculum. The Internal Evaluation for Theory subjects shall be based on two mid-term examinations and two assignments. In every theory subject, out of 40 sessional marks, 30 marks are allotted to mid-term examination and 10 marks for assignments. The best of the performances in the two midterm examinations, one held in the middle of the semester and another held immediately after the completion of the instruction, will be considered. The internal evaluation for practical subjects is based on the day-to-day performance and semester end internal practical Examination.

4.2 The marks for Seminar will be awarded by internal evaluation made by two staff members of the faculty of the department concerned.

4.3 For taking the University examination in any theory or practical subject, candidates shall be required to obtain a minimum of 50% marks in Internal evaluation in that subject failing which he/she shall be required to repeat the course in that subject when next offered or study any other specified subject as may be required. In case of repetition the new internal marks will be taken into amount.

4.4 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he or she secures a minimum of 50% marks in internal evaluation.

4.5 In case the candidate does not secure the minimum academic requirement in any subject he/she has to reappear in the University examination in that subject or any equivalent subject prescribed.

4.6 Failure to attain the minimum academic requirement in any subject of previous semester (s) is no bar for enrolment to the next semester.

4.7 The performance of the students in each semester shall be evaluated subject wise The distribution of marks between sessional work (based on internal assessment) and University Examination will be as follows:

Nature of the subject	Sessional Marks	University Exam. Marks
Theory subjects	40	60
Practical's	40	60
Seminar / Internship / Project Seminar	100	--
Project work	50	150(viva voce)

5.0 AWARD OF CREDITS

Credits are awarded for each Theory/Practical/Seminar/Project Subjects. Each theory subject is awarded 4 credits and each practical/Seminar subjects is awarded 2 credits. Project seminar in III Semester is awarded 8 credits and Project Viva-voce at the end of IV Semester is awarded 16 credits.

6.0 AWARD OF GRADES

S.No.	Range of Marks	Grade	Grade Points
1	≥85%	S	10.0
2	75%-84%	A	9.0
3	65%-74%	B	8.0
4	60%-64%	C	7.0
5	55%-59%	D	6.0
6	50%-54%	E	5.0
7	≤49%	F(Fail)	0.0
8	The grade 'W' represents withdrawal/absent (subsequently changed into pass or E toS or F grade in the same semester)	W	0.0

A Student securing 'F' grade in any subject there by securing 0 grade points has to reappear and secure at least 'E' grade at the subsequent examinations in that subject

'W' denotes withdrawal/absent for a subject:

- After results are declared and Grade sheets will be issued to each student which will contain the following details:
- The list of subjects in the semester and corresponding credits and Grade obtained
- The Grade point average(GPA) for the semester and

- The Cumulative Grade Point Average(CGPA) of all subjects put together up to that semester from first semester onwards

GPA is calculated based on the fallowing formula:

$$\frac{\text{Sum of [No.Credits X Grade Point]}}{\text{Sum of Credits}}$$

CGPA will be calculated in a similar manner, considering all the subjects enrolled from first semester onwards.

7.0 AWARD OF DEGREE AND CLASS

A candidate who becomes eligible for the award of the degree shall be placed in the following three divisions based on the CGPA secured by him/her for the entire Programme

S.No.	Class	CGPA
1	First Class With Distinction	8.0 or more
2	First Class	6.5 or more but less than 8.0
3	Second Class	5.0 or more but less than 6.5

8.0 WITH-HOLDING OF RESULTS

The result of a candidate may be withheld in the following cases

i. The candidate has not paid dues to the institution
ii. A case of indiscipline is pending against the candidate
iii. A case of malpractice in examination is pending against the candidate The issue of degree is liable to be withheld in such cases

9.0 GENERAL

8.1. The University reserves the right of altering the regulations as and when necessary.

8.2 The regulations altered will be applicable to all the candidates on the rolls Irrespective of the fact that the regulations at the time of admission of the student to the programme are different.

8.3 The Academic Regulations should be read as a whole for purpose of any Interpretation Whenever there is a dispute regarding interpretation of regulations, the decision of the Vice-Chancellor is final.

ACHARYANAGARJUNAUNIVERSITY
NAGARJUNA NAGAR
FOUR SEMESTER M.TECH DEGREE COURSE
INDIGITAL IMAGE PROCESSING
CURRICULUM & DETAILED SYLLABI

S.No.	Course Number	Subject	Periods/week		Internal marks	End Semester Examination		Credits
			L+T	P		Duration	Marks	
First Semester								
1.	DIP 511	Digital Signal Processing	4	--	40	3	60	4
2.	DIP 512	Computer Vision	4	--	40	3	60	4
3.	DIP 513	Digital Image Processing	4	--	40	3	60	4
4.		ELECTIVE -1	4	--	40	3	60	4
5.		ELECTIVE-II	4	--	40	3	60	4
6.		ELECTIVE-III	4	--	40	3	60	4
7.	DIP 551	Computer Vision Lab	--	3	40	3	60	2
8.	DIP 552	DIP LAB	--	3	100	--	--	2
		TOTAL	24	6	380	--	420	28
Second Semester								
1.	DIP 514	Advanced Image & Video Processing	4	--	40	3	60	4
2.	DIP 515	Pattern Recognition& Analysis	4	--	40	3	60	4
3.	DIP 516	Multimedia Systems	4	--	40	3	60	4
4.		ELECTIVE -1	4	--	40	3	60	4
5.		ELECTIVE -II	4	--	40	3	60	4
6.		ELECTIVE -III	4	--	40	3	60	4
7.	DIP 553	Advanced Imaging Lab	--	3	40	3	60	2
8.	DIP 554	Multimedia Lab	--	3	100	--	--	2
		TOTAL	24	6	380	--	420	28

Third Semester								
1.	DIP 711	Summer Internship	--	--	100	-[-	--	2
2.	DIP 712	Project Seminar	--	--	100	--	--	6
		TOTAL	--	--	200	--	--	8
Fourth Semester								
1.	DIP 713	Project Viva	--	--	50	--	150	16
		TOTAL	--	--	50	--	150	16

List of Electives:

Subject Code	Subject Title	Prerequisite
DIP 611E	Random Process for Signal Processing	
DIP 612E	Multirate Signal Processing	
DIP 613E	Artificial Neural Networks	
DIP 614E	Fuzzy Logic&Neuro Fuzzy Systems	
DIP 615E	Genetic Algorithms	
PSE 616E	Soft Computing	
DIP 617E	Wavelet Theory	
DIP 618E	Information Theory & Coding	
DIP 619E	Transform Theory	
DIP 620E	Machine Learning	
DIP 621E	Data Engineering	
DIP 622E	Bio Medical Signal Processing	
DIP 623E	Speech & Audio Processing	
DIP 624E	DSP Applications for Multimedia	
DIP 625E	Digital Compression Techniques	
DIP 626E	Embedded Systems	
DIP 627E	Real Time Systems	
DIP 628E	Bioinformatics	--

- 24 credits have to be achieved from Core Subjects.
- 24 credits have to be achieved from Elective Subjects.
- 8 credits have to be achieved from Labs.
- 2 Credits have to be achieved from Internship.
- 22 credits have to be achieved from Project.
- Total 80 credits are required for Awarding the M.Tech Degree.

CORE SUBJECT

DIP 511 DIGITAL SIGNAL PROCESSING L T P

4 0 0 100

UNIT 1

Introduction:

Signals, Systems, and Signal Processing , Classification of Signals, The Concept of Frequency in Continuous-Time and Discrete-Time Signals, Analog-to-Digital and Digital-to-Analog Conversion.

Discrete-Time Signals And Systems:

Discrete-Time Signals, Discrete-Time Systems, Analysis of Discrete-Time Linear Time-Invariant systems, Discrete-Time Systems Described by Difference Equations, Implementation of Discrete-Time Systems2.6 Correlation of Discrete-Time Signals.

The Z-Transform And Its Application To The Analysis Of LTI Systems:

The z-transform,Properties of the z-Transform, Rational z-Transforms, Inversion of the z-Transform, Analysis of Linear Time Invariant Systems in the z-Domain, The One-sided z-Transform

UNIT 2

Frequency Analysis Of Signals And Systems:

Frequency Analysis of Continuous-Time Signals, Frequency Analysis of Discrete-Time Signals, Frequency-Domain and Time-Domain Signal Properties, Properties of the Fourier Transform for Discrete-Time Signals.

Sampling And Reconstruction Of Signals:

Ideal Sampling and Reconstruction of Continuous-Time Signals, Discrete-Time Processing of Continuous-Time Signals, Analog-to-Digital and Digital-to-Analog Converters, Sampling and Reconstruction of Continuous-Time Bandpass Signals, Sampling of Discrete-Time Signals, Oversampling A/D and D/A Converters.

The Discrete Fourier Transform: Its Properties And Applications:

Frequency Domain Sampling:The Discrete Fourier Transform, Properties of the DFT, Linear Filtering Methods Based on the DFT, Frequency Analysis of Signals Using the DFT, The Discrete Cosine Transform.

UNIT 3

Efficient ComputaitonOf The Dft: Fast Fourier Transform Algorithms:

Efficient Computation of the DFT: FFT Algorithms, Applications of FFT Algorithms, A Linear Filtering Approach to Computation of the DFT, Quantization Effects in the Computation of the DFT.

Multirate Digital Signal Processing

Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Implementation of Sampling Rate Conversion, Multistage Implementation of Sampling Rate Conversion, Sampling Rate Conversion of Bandpass Signals, Sampling Rate conversion by an Arbitrary Factor, Applications of Sampling Rate Conversion, Digital Filter Banks, Two-Channel Quadrature Mirror Filter Bank, M-Channel QMF Bank.

UNIT 4

Linear Prediction And Optimum Linear Filters:
Random Signals, Correlation Functions and Power Spectra, Innovations Representation of Stationary Random Process, Forward and Backward Linear Prediction, Solution of the Normal Equations, Properties of the Linear Prediction-Error Filters, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction

Adaptive Filters
Applications of Adaptive Filters, Adaptive Direct-Form FIR Filters-The LMS Algorithm, Adaptive Direct-Form FIR Filters-RLS Algorithms, Adaptive Lattice-Ladder Filters

Power Spectrum Estimation
Estimation of Spectra from Finite-Duration Observations of Signals, Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Filter Bank Methods, Eigenanalysis Algorithms for Spectrum Estimation.

Text book:

1. Digital Signal Processing by John Proakis, DimitrisManolakis 4th Edition (Pearson)

(ISBN13: 9780131873742, ISBN10: 0131873741)

References:

1. Oppeheim& Ronald W Schafer," Digital Signal Processing", Prentice Hall India

CORE SUBJECT

DIP 512	COMPUTER VISION	L	T	P	M
		4	0	0	100

UNIT - I

Review of probability – mean, standard deviation, estimation of parameters from samples. Statistical decision making – Bayes classification, decision region, classification based on multiple features – nearest neighbor classification techniques.
Fundamentals of optical character recognition, skew detection techniques.Three dimensional data from images – geometric camera model and central and parallel projection.Stereo analysis – correspondence establishment. 3D coordinate estimation.

UNIT - II

Binary Machine Vision: Thresholding, Segmentation, Connected component labeling,Hierarchal segmentation, Spatial clustering, Split & merge, Rule-based Segmentation, Motionbased segmentation.

Area Extraction: Concepts, Data-structures, Edge, Line-Linking, 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.

UNIT - III

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.

UNIT - IV

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, InformationIntegration.

Text Books:

1. David A. Forsyth, Jean Ponce, *.Computer Vision: A Modern Approach.*

2. R. Jain, R. Kasturi, and B. G. Schunk, *.Machine Vision.*, McGraw-Hill.

References:

1. Milan Sonka,VaclavHlavac, Roger Boyle, *.Image Processing, Analysis, and*

Machine Vision. Thomson Learning

2. Robert Haralick and Linda Shapiro, *.Computer and Robot Vision.*, Vol I, II, Addison-Wesley, 1993.

CORE SUBJECT

DIP 513	DIGITAL IMAGE PROCESSING	L	T	P	M
		4	0	0	100

UNIT - I

Introduction : Examples of fields that use digital image processing, fundamental steps in digital image processing, components of image processing system.. Digital Image Fundamentals: A simple image formation model, image sampling and quantization, basic relationships between pixels

Image enhancement in the spatial domain : Basic gray-level transformation, histogram processing, enhancement using arithmetic and logic operators, basic spatial filtering, smoothing and sharpening spatial filters, combining the spatial enhancement methods

UNIT - II

Color Image Processing : Color fundamentals, color models, pseudo color image processing, basics of full–color image processing, color transforms, smoothing and sharpening, color segmentation

UNIT - III

Image Compression : Fundamentals, image compression models, error-free compression, lossypredictive coding, image compression standards .

Morphological Image Processing : Preliminaries, dilation, erosion, open and closing, hit or miss transformation, basic morphologic algorithms

UNIT - IV

Image Segmentation : Detection of discontinuous, edge linking and boundary detection, thresholding, region–based segmentation

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TEXT BOOK :

1. Digital Image Processing, RafealC.Gonzalez, Richard E.Woods, Second Edition, Pearson Education/PHI.

REFERENCES :

1. Image Processing, Analysis, and Machine Vision, Milan Sonka, Vaclav Hlavac and Roger Boyle,Second Edition, Thomson Learning.
2. Introduction to Digital Image Processing with Matlab, Alasdair McAndrew, Thomson Course Technology
3. Computer Vision and Image Processing, Adrian Low, Second Edition, B.S.Publications
4. Digital Image Processing using Matlab, RafealC.Gonzalez, Richard E.Woods, Steven L. Eddins, Pearson Education.
5. Digital Image Processing, William K. Prat, Wily Third Edition
6. Digital Image Processing and Analysis, B. Chanda, D. DattaMajumder, Prentice Hall of India, 2003

DIP 551	COMPUTER VISION LAB	L	T	P	M
		0	0	3	100

Instructions:
• Use OpenCV and a webcam to complete this assignment.
• Submit your codes and images or videos.
.
Objectives:
• Learn about camera geometry.
• Learn to calibrate camera using OpenCV functions.
• Learn to obtain and save camera intrinsic and distortion parameters.
• Learn to undistort image from camera.
• Learn to perform pose estimation of a known object.
• You can use either C or C++ version. All functions shown in this document are C++ functions.
Cycle 1:
• Download Camera Calibration Images (bitmap or JPEG format) from the class website.
• Write your code to read in one of those calibration images.
• The input image must first be converted to grayscale using cvtColor() function (CV_RGB2GRAY).
• Use OpenCV function findChessboardCorners() to find chessboard inner corners.
• Use OpenCV function cornerSubPix() to refine corner locations.
• Use OpenCV function drawChessboardCorners() to draw corners.
• Save and submit one output image (with corners circled).
• This task is only an intermediate stage of calibration procedure. You don't have to submit your code.
Cycle 2:
• Write a program to read in all 40 of the calibration images one at a time in a loop.
• In the loop, find chessboard corners for each input image.
• Arrange corner points in the format for calibrateCamera() function. You need to learn how to use vector and vector of vectors if
you use C++ (Google or email me if you need help).
• Use OpenCV function calibrateCamera() to calculate the intrinsic and distortion parameters.
• Save and submit the intrinsic and distortion parameters.
• Submit your code for this task.
Cycle 3: 20 points
• Write another program to read in your saved intrinsic and distortion parameters from file(s).
• Download the three test images (Far, Close, Turned).
• Use OpenCV function undistort() to correct the distortion of these three images.
• Use OpenCV function absdiff() to compute the absolute difference between the original and undistorted images.
• Save and submit the three difference images.
• Submit your code for this task.
Cycle 4:

• Download the “Object with Corners” image to see the known object. You don’t have to process this image. Data are provided.
• Download the data file DataPoints.txt that has 20 image points (for x and y in pixels) and 20 object points (for x, y, z in inches).
• Write a program to read in the image and object points.
• Use the C++ version solvePnP() function or C version cvPOSIT() to estimate the object pose (measured by the camera).
• Submit your code and the output rotation and translation matrices.

Cycle 5: • Repeat Task 2 (including saving calibration parameters in a file) using your own camera.
• You can use your real-time acquisition code for Assignment 2 to capture images.
• Use the chessboard for Assignment 2 and your code for Task 2 above to calibrate your camera.
• Make sure to change the number of corners entered to the calibration function in your code for Task 2.
• Make sure the chessboard paper is on a planar surface.
• Save and submit the intrinsic and distortion parameters of your camera.
• Submit your code for this task.

Cycle 6:

• Repeat Task 3 (including reading calibration parameters from a file) using your own camera.
• Save and submit a video or an image of the absolute difference between the original (captured from your camera) and the undistorted images.
• Submit your code for this task.

DIP 552	DIGITAL IMAGE PROCESSING LAB	L	T	P	M
		0	0	3	100

Using Matlab Image Processing Toolbox.implement following problems

1. Image Manipulation. Read, write, view images and conversion between di_erent formats. Main Matlab functions: imread, imwrite,gray2ind, ind2gray, ind2rgb, mat2gray, rgb2gray, rgb2ind.
2. Spacial Transformations. Convolution and correlation. Main Matlab functions: imfilter, conv2,filter2.
3. Frequency Transformations. Fourier transform.MainMatlab functions: fft2, ifft2,fftshift.
4. Histogram Modification. Explore histogram as an enhancement technique. Main Matlab functions: imhist, histeq, imadjust.
5. Filtering. Noise identification and filtering techniques to remove it. Main Matlab functions: imnoise, medfilt2, ordfilt2, wiener2.
6. Morphological Transformations. Dilatation and erosion as fundamental morphological operations. Main Matlab functions: imdilate, imerode, imclose, imopen, bwmorph.
7. Segmentation using Edge Detection. Detection of boundaries between two regions using different gradient aproximations. Main Matlab function: edge.
8. Segmentation using Thresholding. Divide the image in regions depending on the graylevel. Main Matlab function: im2bw.

CORE SUBJECT

DIP 514	ADVANCED IMAGE & VIDEO PROCESSING	L	T	P	M
		4	0	0	100

UNIT I

Image representation: Gray scale and colour Images, image sampling and quantization.Two dimensional orthogonal transforms: DFT, WHT, Haar transform, KLT, DCT. Imageenhancement - filters in spatial and frequency domains, histogram-based processing,homomorphic filtering. Edge detection - non parametric and model based approaches,LOG filters, localization problem.

UNIT II

Image Restoration: Degradation Models, PSF, circulant and block - circulantmatrices,deconvolution, restoration using inverse filtering, Wiener filtering and maximumentropy-based methods. Image Segmentation: Pixel classification, Bi-level thresholding,Multi-level thresholding, P-tile method, Adaptive thresholding, Spectral & spatialclassification, Edge detection, Hough transform, Region growing.

UNIT III

Fundamental concepts of image compression - Compression models - Information theoretic perspective - Fundamental coding theorem - Lossless Compression: HuffmanCoding- Arithmetic coding - Bit plane coding - Run length coding - Lossycompression:Transform coding - Image compression standards.

UNIT IV

Object Recognition : Patterns and patterns classes, recognition based on decision–theoretic methods, matching, optimum statistical classifiers, neural networks, structural methods – matching shape numbers, string matching
Video Processing: Representation of Digital Video, Spatio-temporal sampling; Motion Estimation; Video Filtering; Video Compression, Video coding standards.

Text Books

1. *A. K. Jain*, Fundamentals of digital image processing, Prentice Hall of India, 1989.
2. *R. C. Gonzalez, R. E. Woods, Digital Image Processing,* Pearson Education. II Ed.,2002
3. *A. M. Tekalp*, Digital Video Processing , Prentice-Hall, 1995
4. *A. Bovik*, Handbook of Image & Video Processing, Academic Press, 2000

References:

1. *W. K. Pratt*, Digital image processing, Prentice Hall, 1989
2. *A. Rosenfeld and A. C. Kak*, Digital image processing, Vols. 1 and 2, Prentice Hall,
1986.
3. *H. C. Andrew and B. R. Hunt*, Digital image restoration, Prentice Hall, 1977

CORE SUBJECT

DIP 515	**PATTERN RECOGNITION & ANALYSIS**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT I

Introduction - features, feature vectors and classifiers, Supervised versus unsupervisedpattern recognition. Classifiers based on Bayes Decision theory-introduction,discriminant functions and decision surfaces, Bayesian classification for normaldistributions, Estimation of unknown probability density functions, the nearest neighbor rule. Linear classifiers,- Linear discriminant functions and decision hyper planes, Theperceptron algorithm, MSE estimation, Logistic determination, Support Vector machines.

UNIT II

Non-Linear classifiers- Two layer and three layer perceptrons, Back propagation algorithm, Networks with Weight sharing, Polynomial classifiers, Radial Basis functionnetworks, Support Vector machines-nonlinear case, Decision trees, combining classifiers, Feature selection, Receiver Operating Characteristics (ROC) curve, Class separability measures, Optimal feature generation, The Bayesian information criterion

UNIT-III

Feature Generation 1- Linear transforms-KLT, SVD, ICA, DFT, DCT, DST, HadamardTransform, Wavelet Transform, Wavelet Packets etc- Two dimensional generalizations -Applications. Feature Generation 2- regional features, features for shape andcharacterization, Fractals, typical features for speech and audio classification, TemplateMatching, Context dependent classification-Bayes classification, Markov chain models,HMM, Viterbi Algorithm. System evaluation - Error counting approach, Exploiting thefinite size of the data.

UNIT IV

Clustering- Cluster analysis, Proximity measures, Clustering Algorithms - Sequential algorithms, Neural Network implementation. Hierarchical algorithms - Agglomerative algorithms, Divisive algorithms. Schemes based on function optimization - Fuzzy clustering algorithms, Probabilistic clustering, K - means algorithm. Clustering algorithms based on graph theory , Competitive learning algorithms, Binary MorphologyClustering Algorithms Boundary detection methods, Valley seeking clustering, Kernelclustering methods. Clustering validity.

Text books

1. *SergiosTheodoridis, KonstantinosKoutroumbas*, “Pattern Recognition”, Academic Press, 2006.
2. *Duda and Hart P.E*, Pattern classification and scene analysis, John Wiley and sons, NY, 1973.
3. *Earl Gose, Richard Johnsonbaugh, and Steve Jost*; Pattern Recognition and Image Analysis, PHI Pvt..Ltd., NewDelhi-1, 1999.
4. *Fu K.S*., Syntactic Pattern recognition and applications, Prentice Hall, Eaglewood

CORE SUBJECT

DIP 516	MULTIMEDIA SYSTEMS	L	T	P	M
		4	0	0	100

UNIT-I
Fundamental concepts in Text and Image: Multimedia and hypermedia, world wide web, overview of multimedia software tools. Graphics and image data representation graphics/image data types, file formats, Color in image and video: color science, color models in images, color models in video.
Fundamental concepts in video and digital audio: Types of video signals, analog video, digital video, digitization of sound, MIDI, quantization and transmission of audio.

UNIT - II

Multimedia data compression : Lossless compression algorithm: Run-Length Coding, Variable Length Coding, Dictionary Based Coding, Arithmetic Coding, Lossless Image Compression, Lossy compression algorithm: Quantization, Transform Coding, Wavelet-Based Coding, Embedded Zerotree of Wavelet Coefficients Set Partitioning in Hierarchical Trees (SPIHT).

UNIT - III

Basic Video Compression Techniques: Introduction to video compression, video compression based on motion compensation, search for motion vectors, MPEG, Basic Audio Compression Techniques.

UNIT - IV

Multimedia Networks: Basics of Multimedia Networks, Multimedia Network Communications and Applications : Quality of Multimedia Data Transmission, Multimedia over IP, Multimedia over ATM Networks, Transport of MPEG-4, Media-on-Demand(MOD).

TEXT BOOKS :

1. Fudamentals of Multimedia by Ze-Nian Li and Mark S. Drew PHI/Pearson Education.
2. Essentials ActionScript 2.0, Colin Moock, SPD O,REILLY.

REFERENCES :

1. Digital Multimedia, Nigel chapman and jenny chapman, Wiley-Dreamtech
2. Macromedia Flash MX Professional 2004 Unleashed, Pearson.
3. Multimedia and communications Technology, Steve Heath, Elsevier(Focal Press).
4. Multimedia Applications, Steinmetz, Nahrstedt, Springer.
5. Multimedia Basics by Weixel Thomson
6. Multimedia Technology and Applications, David Hilman ,Galgotia

DIP 553	ADVANCED IMAGE PROCESSING LAB	L	T	P	M
		0	0	3	100

Problem –I Recoloring

In this assignment you are required to run a MATLAB program to produce the **recoloring** results of some color images. In their colorization approach you may draw some color scribbles on a graylevel image, and the colors of the scribbles are automatically propagated to yield a fully colorized image.

INPUT IMAGE

SCRIBBLED IMAGE

RECOLORING RESULT

You need to download the MATLAB code of Levin *et al.* and do the following steps to complete this assignment.

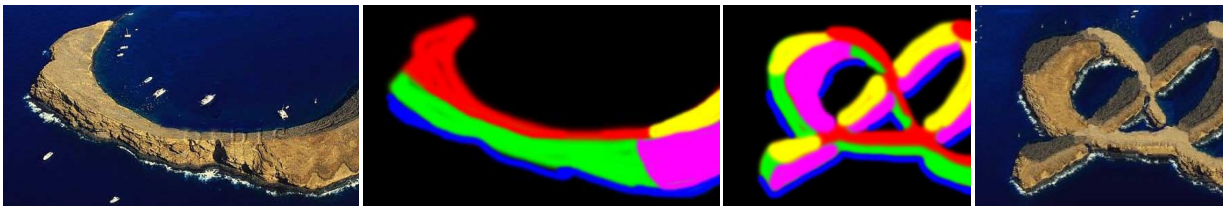
1. Shoot some color pictures of buildings, signs, or logos around that you want to recolor them to make them look more attractive. You may also use the images here for recoloring.

2. Shoot some color pictures of which the color you like very much as the "palettes" when you draw scribbles. You may skip this step if you like to choose your own color combinations.

3. Modify the function 'colorizeFun.m' included in the MATLAB code of Levin *et al.*, and use it to do recoloring on the pictures you take. You may refer to those pictures taken in Step 2 as exemplars of recoloring when you draw the color scribbles. **Note that, to make the MATLAB code work, the scribbled images must not be compressed**. The scribbled images need to be identical to the input images everywhere except at the positions of scribbles.

4. Create a web page to demonstrate your artifacts. You also need to describe what you have done step by step.

Problem-II



input image | labeled image | rearranged | output image

In this assignment you are required to run the Image Analogies software to do texture-by-numbers. (The Image Analogies software is written by Aaron Hertzmann and Chuck Jacobs; you might also need GLUT.)
Please create two or more results of texture-by-numbers.
Collections of public domain images that you can use in your assignment.
You need to create a web page presenting your results. You may give some brief descriptions to explain how you completed this assignment and what problems you encountered.

Problem-III Seam Carving

In this assignment you are required to test the basic algorithm presented in "Seam Carving for Content-Aware Image Resizing. You may download the following Matlab implementations of the Seam Carving algorithm, and use them to do object removal and image inpainting: i) Matlab implementation, ii) GUI, iii) example code of drawing with the mouse.

Problem-IV Intrinsic Images

INPUT | LIGHTING #4 | LIGHTING #6 | REFLECTANCE | COMPOSITE: LIGHTING #4 + LIGHTING #6 + REFLECTANCE

In this assignment you are required to compute intrinsic images from an image sequence using Weiss's Matlab code of the method presented in his paper.
You need to **capture multiple images of the same object/scene under different lighting conditions**. The estimated reflectance will be more accurate if the lighting conditions change a lot among different images. You may use a webcam to capture the images. Typical image resoultion of webcam (e.g., 320x240 pixels) would be enough for this assignment. You may control the lighting conditions using flashlights or desk lamps. Please create a web page presenting your results. You may give some brief descriptions to explain how you completed this assignment and what problems you encountered.

Problem-V Matting

In this assignment you are required to take **3 or more** pictures by yourself, and then run MATLAB programs to blend those images into a single image by matting (2 for the foreground objects and 1 for the background). You will try the MATLAB code released by Levin, Lischinski, and Weiss. Similar to the technique used in the colorization assignment, you need to draw scribbles on source images to create the mattes (or the alpha channels). You then just integrate the mattes to produce the final composite image

DIP 554	MULTIMEDIA LAB	L	T	P	M
		0	0	3	100

1. Preproduction&Presentation Graphics:Create a7-10slidepresentationinyourfavorite presentationgraphicsapplication.(Powerpoint issuggested; CorelPresentations9isfreeandis acceptable.)

2. Typefacesand Graphics:Create1vectorand1bitmapgraphic;theymust be*youroriginal work* created inanyoftheacceptabletools.

3. DesktopPublishing:Create a2-page desktop-published"newsletter," possiblyusingyour "Whatis Multimedia?"text.Includegraphics.

4. ProductionPlanning andDesign:Createa proposalofproject.Includesummary,flowchart, elementandresource lists.

5. UserInterfaceDesign&GraphicsII:Create a userinterfaceforyour finalproject.Include2 backgrounds and1buttonset.Aimforacohesive look.

6. MultimediaSound:Create 2soundtracks and2EFXsoundsforapreviousproject.

7. DigitalVideo:Usevideocapturetodigitizeyourvideoshootroanothervideosourceto createshort production (15-45seconds)

8. Createthree basic WebpagesusingDreamweaver /flashorotherauthoringpackageorwritebare HTMLifyouareable;pagesmustbelinkedand mustincludeatleast one graphicper page.

Books:

1) PrabhatK.Andleigh&KiranThakrar,“ Mulitmedia Systems Design”,Prentice Hallof India, New Delhi.
2) CalleenCoorough,“Multimediaand theWeb Creating digitalExcitement”,VikasPublishing House, New Delhi.
3) JamesE.Shuman,“Multimediain Action”,VikasPublishingHouse,NewDelhi.

ELECTIVE

DIP611E	**RANDOM PROCESS FOR SIGNALS**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT I

Probability space: - Motivation for probability- Coin and die tossing. Set representation,subset and complement of a set. De Morgan's laws.Finite and countable sets, settheoretic difference (A\B).Sample space, field, σ-field, Borel set, Probability space.

UNIT II

Random Variable :- Definition of random variable, dynamical system. Continuous anddiscrete random variable. Probability mass function and Probability density function,Cumulative distribution function, Basic distribution functions- binomial, uniform,exponential and normal. Properties of these distribution functions.

Random Vector: - Definition of random vector. Joint statistics.Independent events andconditional probability. Bayes Rule. Total probability theorem. Sum and transformationof random variables.

UNIT III

Characteristic Function: - Expectation, variance and characteristics function, moments.Properties of characteristics function, Covariance and correlation. Fundamental Theoremof expectation.

Random process: - Definition of Random process, IID process, Poisson process, properties of Poisson process, Markov process, birth-death process, Wiener process

UNIT IV

Convergence: - Markov and Chebyshev inequalities, weak and strong law of large numbers, Central Limit Theorem. Convergence of random sequences- almost sure convergence, convergence in probability, convergence in mean

Stationarity: - Stationary and ergodic process – point-wise ergodic theorem, ergodic decomposition.

Text Books

1. *AthanasiosPapoulis , S. UnnikrishnaPillai*, Probability, Random Variables and Stochastic Processes, TMH
2. *Henry Stark , John W Woods,* Probability and Random Processes With Application to
Signal Processing, 3/e, Pearson Education India

References:

1. *Geoffrey Grimm* , Probability and Random Processes, 3rd edition, 2001, Oxford University Press
2. *V. Krishnan*, Probability and Random Processes, 2006, John Wiley & Sons
3. *Albert Leon Garcia*, Probability and Random Processes for Electrical Engineering, 1993, Prentice Hall
4. *Dr. Kishor S. Trivedi*, Probability and Statistics with Reliability, Queuing, and Computer Science Applications, John Wiley and Sons, New York, 2001.
5. *Kingsbury N.,* Random Processes [Connexions Web site]. January 22, 2004.
6. *Gray, R. M. and Davisson L. D*. ,An Introduction to Statistical Signal Processing.

ELECTIVE

DIP612E	**MULTIRATE SIGNAL PROCESSING**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT I

Fundamentals of Multirate Theory: The sampling theorem - sampling at subnyquist rate -Basic Formulations and schemes.BasicMultirate operations- Decimation and Interpolation - Digital Filter Banks- DFT Filter Bank- Identities- Polyphase representation

Maximally decimated filter banks: Polyphase representation - Errors in the QMF bank-

Perfect reconstruction (PR) QMF Bank - Design of an alias free QMF Bank

UNIT II

M-channel perfect reconstruction filter banks: Uniform band and non uniform filter bank

- tree structured filter bank- Errors created by filter bank system- Polyphase representation- perfect reconstruction systems

UNIT III

Perfect reconstruction (PR) filter banks: Paraunitary PR Filter Banks- Filter Bank Properties induced by paraunitarity- Two channel FIR paraunitary QMF Bank- Linear phase PR Filter banks- Necessary conditions for Linear phase property- Quantization

Effects: -Types of quantization effects in filter banks. - coefficient sensitivity effects, dynamic range and scaling.

UNIT IV

Cosine Modulated filter banks: Cosine Modulated pseudo QMF Bank- Alias cancellation phase- Phase distortion- Closed form expression- Polyphase structure- PR Systems

Text Books

1. *P.P. Vaidyanathan*. Multirate systems and filter banks. Prentice Hall.PTR. 1993.
2. *N.J. Fliege*. Multirate digital signal processing .John Wiley 1994.

References:

1. *Sanjit K. Mitra*. Digital Signal Processing: A computer based approach. McGraw Hill.
1998.
2. *R.E. Crochiere. L. R.* Multirate Digital Signal Processing, Prentice Hall.Inc.1983.
3*. J.G. Proakis. D.G. Manolakis*. Digital Signal Processing: Principles. Algorithms and
Applications, 3rd Edn. Prentice Hall India, 1999

ELECTIVE

DIP613E	**ARTIFICIAL NEURAL NETWORKS**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT-1

Characteristics of Neural Networks, Historical Development of Neural Networks Principles, Artificial Neural Networks: Terminology, Models of Neuron, Topology, Basic Learning Laws, Pattern Recognition Problem, Basic Functional Units, Pattern Recognition Tasks by the Functional Units.

UNIT - II

Feedforward Neural Networks:

Introduction, Analysis of pattern Association Networks, Analysis of Pattern Classification Networks, Analysis of pattern storage Networks.Analysis of Pattern Mapping Networks.

UNIT - III

Feedback Neural Networks

Introduction, Analysis of Linear Autoassociative FF Networks, Analysis of Pattern Storage Networks.

UNIT - IV

Competitive Learning Neural Networks & Complex pattern Recognition

Introduction, Analysis of Pattern Clustering Networks, Analysis of Feature Mapping Networks, Associative Memory.

TEXT BOOKS :

1. Artificial Neural Networks B. YagnaNarayana, PHI

REFERENCES :

1. Artificial Intelligence and Expert Systems – Patterson PHI.
2. Expert Systems: Principles and Programming- Fourth Edn, Giarrantana/ Riley, Thomson.
3.Neural Networks Simon Haykin PHI

ELECTIVE

DIP614E	**FUZZY LOGIC&NEURO FUZZY SYSTEMS**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT – I

Supervised and unsupervised learning.Perception learning algorithm – multilayer perception – Kohorensself organizing networks – Hop field networks – The Boltzmann machine – Adaptive Resonance theory.VIntroduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT II

Fuzzy Logic System Components

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

UNIT-III

Applications

Neural network applications: Process identification, control, fault diagnosis and load forecasting.

Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.

UNIT-IV

Fuzzy control systems – simple examples – Model based and learning based fuzzy control – Neural networks and fuzzy systems – Fuzzy neural control – Back propagation based neural network fuzzy controller

TEXT BOOK

1. Bart Kosko – “Neural Networks and Fuzzy Systems”

Reference

2. JunhongNie&DerkLinkens - “Fuzzy Neural Control (PHI)
3. Haykin S – “Neural Networks, a comprehensive foundation” – Pearson Education
4. YegnaNarayana B – “Artificial Neural Networks” – PHI
5. G J Klir& Tina A Folger – “Fuzzy sets, Uncertainty and Information”

Timothy J Ross – “Fuzzy logic with Engineering Applications

ELECTIVE

DIP615 E	**GENETIC ALGORITHMS**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT I

A Gentle Introduction to Genetic Algorithms; Genetic Algorithms revisited-Mathematical Foundations: The Fundamental Theorem, Schema Processing at work, Two-armed and k-armed Bandit problem, The Building block hypothesis.

UNIT II

Computer implementation of a genetic algorithm: Reproduction, crossover and Mutation, Fitness Scaling, Codings, Discretization. Some applications of genetic algorithms.

UNIT III

Advanced operators and techniques in genetic search: Dominance, Diploidy and Abeyance. Inversion and other reordering operators, Niche and speciation, Knowledge based Techniques, Genetic Algorithms and parallel processors.

UNIT IV

Introduction to genetics based machine learning: Classifier system, Rule and Message system, Apportionment of credit, A Classifier system in pascal.

Applications of genetics based machine learning: The Rise of GBML, Development of CS-1, Smith Poker player, other Early GBML efforts.

Text Book

1. David E.Goldberg, Genetic Algorithms in search , Optimization & Machine Learning Pearson Education.

Reference Books:

1. William B. Langdon, Riccardo Poli,Foundations of Genetic Programming
2. P. J. Fleming, A. M. S. Zalzala Genetic Algorithms in Engineering Systems
3. David A. Coley, An Introduction to Genetic Algorithms for Scientists and Engineers

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ELECTIVE

DIP616E	**SOFT COMPUTING**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT I FUZZY SYSTEMS

Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

UNIT II OPTIMAIZATION

Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search.

UNIT III NEURAL NETWORKS

Supervised Learning Neural Networks – Perceptrons - Adaline – BackpropagationMutilayerPerceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hebbian Learning.

UNIT IV NEURO FUZZY MODELING

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.

APPLICATIONS OF COMPUTATIONAL INTELLIGENCE

Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction.

TEXT BOOK

1.J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004.

REFERENCES

1.Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.
2. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
3. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic

Algorithms", PHI, 2003.
4. R.Eberhart, P.Simpson and R.Dobbins, "Computational Intelligence - PC Tools", AP Professional, Boston, 1996

ELECTIVE

DIP617E	**WAVELET THEORY**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT I

Generalized Fourier theory, Fourier transform, Short-time(windowed) Fourier transform,
Time-frequency analysis, Fundamental notions of the theory of sampling. Theory of Frames, Bases, Resolution of unity, Definition of frames, Geometrical considerations and the general notion of a frame, Frame projector, Example – windowed Fourier frames.

UNIT II

Wavelets, The basic functions, Specifications, Admissibility conditions, Continuous wavelet transform (CWT), Discrete wavelet transform (DWT). The multiresolution analysis (MRA) of *L2(R)* , The MRA axioms, Construction of an MRA from scaling functions - The dilation equation and the wavelet equation, Compactly supported orthonormal wavelet bases - Necessary and sufficient conditions for orthonormality.

UNIT III

Regularity and selection of wavelets, Smoothness and approximation order - Analysis in
Sobolev space, Criteria for wavelet selection with examples. Construction of wavelets
Splines, Cardinal B-spline MRA, Subband filtering schemes, Compactly supported orthonormal wavelet bases.

UNIT-IV

Wavelet transform**,** Wavelet decomposition and reconstruction of functions in *L2(R)*. Fast wavelet transform algorithms – Relation to filter banks, Wavelet packets – Representation of functions, Selection of basis. Construction of wavelets , Biorthogonality and biorthogonal basis, Biorthogonal system of wavelets - construction,
The Lifting scheme.

Text books

1. *Stephen G. Mallat,* "A wavelet tour of signal processing" 2nd Edition Academic Press, 2000.
2. *M. Vetterli, J. Kovacevic*, "Wavelets and subband coding" Prentice Hall Inc, 1995

References:

1. *Gilbert Strang and Truong Q. Nguyen*, "Wavelets and filter banks" 2nd Edition Wellesley-Cambridge Press, 1998.

ELECTIVE

DIP618E	**INFORMATION THEORY & CODING**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT I

Introduction to Information Theory.Concept of amount of information, units – entropy,marginal, conditional and joint entropies – relation among entropies – mutualinformation, information rate. Source coding: Instantaneous codes – construction ofinstantaneous codes – Kraft's inequality, coding efficiency and redundancy, Noiselesscoding theorem – construction of basic source codes – Shannon – Fano Algorithm,Huffman coding, Channel capacity – redundancy and efficiency of a channel, binarysymmetric channel (BSC), Binary erasure channel (BEC) – capacity of band limitedGaussian channels, Shannon – Hartley theorem – bandwidth – SNR trade off – capacityof a channel of infinite bandwidth, Shannon's limit

UNIT II

Introduction to rings , fields, and Galois fields. Codes for error detection and correction –parity check coding – linear block codes – error detecting and correcting capabilities –generator and parity check matrices – Standard array and syndrome decoding – perfectcodes, Hamming codes – encoding and decoding, cyclic codes – polynomial and matrixdescriptions – generation of cyclic codes, decoding of cyclic codes, BCH codes –description and decoding, Reed – Solomon Codes, Burst error correction.

UNIT III

Convolutional Codes – encoding – time and frequency domain approaches, State Tree &Trellis diagrams – transfer function and minimum free distance – Maximum likelihooddecoding of convolutional codes – The Viterbi Algorithm. Sequential decoding,.Cryptography : Secret key cryptography, block and stream ciphers. DES, Public keycryptography.

UNIT IV

Rate distortion theory- Introduction - Rate Distortion Function - Properties – ContinuousSources and Rate Distortion measure – Rate Distortion Theorem - Converse -Information Transmission Theorem - Rate Distortion Optimization

Text Books

1. *T. Cover and J. Thomas*, Elements of Information Theory, John Wiley & Sons 1991.
2. *Taub& Schilling*, Principles of communication systems, TMH.
3. *Shulin& Daniel J. Costello*, Error control coding – Fundamentals and Application, Prentice Hall Ed.

References:

1. *Robert Gallager*, "Information Theory and Reliable Communication", John Wiley & Sons.
2. *R. J. McEliece*, "The theory of information & coding", Addison Wesley Publishing Co., 1977.

3. *T. Bergu*, Rate Distortion Theory a Mathematical Basis for Data Compression, PH Inc.1971.

ELECTIVE

DIP619E	**TRANSFORM THEORY**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT I

The Discrete Time Fourier Transform :*l2(*Z*)*, Hilbert Spaces, Complete Orthonormal Sets in Hilbert Spaces, *L2([-π,π])* and Fourier Series, The Fourier Transform and Convolution on *l2(*Z*).* The Fourier Transform :*L2(*R*)* and Approximate Identities. The Fourier Transform on R, The Karhunen-Loèvetransform : Whitening of a Random Process.Optimal Transform.Dimensionality Reduction. Independent Component Analysis.

UNIT II

2D Transformation **-**Basic transformations: translation, rotation, scaling; Matrix representations& homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines.Viewing -Viewing pipeline, Window to Viewport co-ordinate transformation, clippingoperations, point clipping, line clipping, clipping circles, polygons & ellipses.

UNIT III

3D Transformation & Viewing -3D transformations: translation, rotation, scaling & othertransformations. Rotation about an arbitrary axis in space; reflection through an arbitraryplane; general parallel projection transformation; clipping, Viewport clipping, 3Dviewing, perspectives & Depth Cueing.

UNIT IV

Curves and Fractals -Curve representation, surfaces, designs, Bezier curves, B-splinecurves, end conditions for periodic B-spline curves, rational B-spline curves. Hidden Surfaces -Depth comparison, Z-buffer algorithm, Back face detection, BSP treemethod, the Printer's algorithm, scan-line algorithm; Hidden line elimination, wire framemethods, fractal - geometry.Color & Shading Models- Introduction, Modeling Light Intensities and Sources, DiffuseReflection, Lambert's Cosine Law, Specular Reflection, Halftoning, Color Models – RGBColor, CMY Color.

Text Books

1. *D. F. Rogers, J. A. Adams*, Mathematical Elements for Computer Graphics (2nd Ed.)– TMH

References:

1*. Michael W. Frazier*, An Introduction to Wavelets Through Linear Algebra, Springer.
2. *AapoHyvärinen, JuhaKarhunen, and ErkkiOja*, Independent component analysis, John Wiley
3. *Hearn, Baker* , Computer Graphics (C version 2nd Ed.)– Pearson education
4. *Z. Xiang, R. Plastock*,Schaum's outlines Computer Graphics (2nd Ed.)– TMH
5. *Mukherjee*, Fundamentals of Computer graphics & Multimedia, PHI
6. *Sankar P.*, Multimedia –A Practical Approach, Jaico
7. *Buford J. K*. – Multimedia Systems– Pearson Education

ELECTIVE

DIP620E	**MACHINE LEARNING**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT – I

Introduction to machine learning

Concept Learning and the General to Specific Ordering: Concept learning task, concept learning as search,Find-S: finding a Maximally Specific hypothesis, Version Spaces and the Candidate-Elimination algorithm, remarks on Version Spaces and Candidate-Elimination andinductive bias.

Decision Tree Learning: Decision Tree representation, appropriate problems for Decision Tree learning, hypothesis space search in Decision Tree learning, inductive bias in Decision Treelearning and issues in Decision Tree learning.

UNIT – II

Artificial Neural Networks: Neural Network representations, appropriate problems for Neural Network learning, Perceptrons, Multilayer Networks and the Backpropagation algorithm and remarks on the Backpropagation algorithm.

Evaluating Hypotheses: Estimating hypothesis accuracy, basics of sampling theory, generalapproach for deriving confidence intervals, difference in error of two hypotheses andcomparing learning algorithms.

UNIT – III

Bayesian Learning: Bayes theorem and concept learning, maximum likelihood and least squared error hypotheses, maximum likelihood hypotheses for predicting probabilities, minimum description length principle, Bayes optimal classier, Gibbsalgorithm, Naive Bayes classier, Bayesian belief networks and EM algorithm.

Computational learning theory: Introduction, probably learning an approximately correcthypothesis, sample complexity for finite hypothesis spaces, and sample complexity forinfinite hypothesis spaces and mistake bound model of learning.

UNIT – IV

Instance Based Learning: Introduction, k-Nearest Neighbor learning, locally weighted regression, radial basis functions, Case Based Reasoning and remarks on Lazy and Eager learning.

Genetic Algorithms: Introduction, hypothesis space search, Genetic programming and models of evolution and learning.

TEXT BOOKS:

1. Tom M. Mitchell, "Machine Learning", Mc. Graw Hill Publishing.

ELECTIVE ELECTIVE

DIP621E DATA ENGINEERING L T P M

4 0 0 100

UNIT – I (18 Periods)

Data Warehouse – Introduction, A Multi-dimensional data model, Data Warehouse Architecture, Data Warehouse Implementation.

Data Mining – Introduction, Data Mining, Kinds of Data, Data Mining Functionalities, Classification of Data Mining Systems, Major issues in Data Mining.

UNIT – II (18 Periods)

Data Preprocessing – Data cleaning, Data Integration & Transformation, Data Reduction, Discretization & Concept Hierarchy Generation, Data Mining Primitives.

Mining Association roles in large databases – Association rule mining, mining single-dimensional Boolean Association rules from Transactional Databases, Mining Multi-dimensional Association rules from relational databases & Data Warehouses.

UNIT – III (15 Periods)

Cluster Analysis – Introduction, Types of data in Cluster analysis, A categorization of major clustering methods, partitioning methods, Hierarchical methods, Density-Based Methods: DBSCAN, Grid-based Method: STING; Model-based Clustering Method: Statistical approach, Outlier analysis.

UNIT – IV (20 Periods)

Classification & Prediction – Introduction, Classification by Decision tree induction, Bayesian Classification, , Classification by Back propagation, Other Classification Methods, Prediction, Classifier accuracy.

Mining Complex Type of Data – Multidimensional Analysis and Descriptive Mining of Complex Data Objects, Mining Spatial Databases, Mining Multimedia Databases, Mining Text Databases, Mining the World Wide Web.

Textbooks:

1.Data Mining Concepts & Techniques – Jiawei Han MichelineKamber – Morgan Kaufmann Publishers.

Reference Books:

1. Data Warehouse Toolkit – Ralph Kinball – John Wiley Publishers.
2. Data Mining (Introductory and Advanced Topics) – Margaret H.Dunham – Pearson Education.
3. Data Warehousing in the real world – A Practical guide for Building decision support systems – Sam Anahory, Dennis Murray – Pearson Education.
4. Introduction to Data Mining with case studies – G.K.Gupta, PHI Publications, 2006

ELECTIVE

DIP622E	**BIOMEDICAL SIGNAL PROCESSING**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT-I

Short introduction -Discrete time systems and signals; Z-transform, Difference equation. Filter design by transformation - Impulse and step Invariant, Bi-linear Z-transform, matched Z-transform.

UNIT-II

Signal Model-AR, MA, ARMA, State Variable model, Lattice structures. FIR filter design, Frequency windowing technique, Equi ripple Chebyshev and Butterworth criterion. Filter performance and design in presence of noise, FIR filters banks-subband decomposition. Inverse filtering-Deconvolution and equalization techniques-Weiner, Linear prediction etc.,

UNIT-III

Signal reconstruction. Time frequency Analysis - STFT, WT, DSP hardware - Design methodologies, Popular architectures and overview of programming Application notes.

UNIT-IV

Filter implementation: Topology, Scaling, Coefficient quantization, Signal quantization, Sensitivity analysis.

TEXT BOOKS

1. Oppenheim & Ronald W Schafer, *Digital Signal Processing*, Prentice Hall India, 2005

2. Wills J. Tompkins, *Biomedical digital signal processing*, Prentice Hall of India Pvt. Ltd. 1993

3. D.C.Reddy, *Biomedical Signal Processing – Principles and Technique*, Tata McGraw-Hill.,2005

ELECTIVE

DIP623E	**SPEECH & AUDIO PROCESSING**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT - I

Mechanism of speech production - Acoustic theory of speech production (Excitation, Vocal tract model for speech analysis, Formant structure, Pitch)- digital models - linear prediction of speech - AR Model, ARMA model -auto correlation - formulation of
LPC equation - solution of LPC equations - Levinson Durbin algorithm - Levinson recursion - Schur algorithm – lattice formulations and solutions - PARCOR coefficients -
Spectral analysis of speech - Short Time Fourier analysis - filter bank design. Auditory
Perception: Psychoacoustics- Frequency Analysis and Critical Bands – Masking properties of human ear.

UNIT II

Speech coding -subband coding of speech - transform coding - channel vocoder – formant vocoder – cepstralvocoder - vector quantizer coder- Linear predictive Coder. Speech synthesis - pitch extraction algorithms - gold rabiner pitch trackers - autocorrelation pitch trackers - voice/unvoiced detection - homomorphic speech processing – homomorphic systems for convolution - complex cepstrums – pitch extraction using homomorphic speech processing. Sound Mixtures and Separation - CASA, ICA & Model based
separation.

UNIT III

Speech Transformations - Time Scale Modification - Voice Morphing. Automatic speech
recognition systems - isolated word recognition - connected word recognition -large vocabulary word recognition systems - pattern classification - DTW, HMM - speaker recognition systems - speaker verification systems – speaker identification Systems.

UNIT IV

Audio Processing : Non speech and Music Signals - Modeling -Differential, transform andsubband coding of audio signals & standards - High Quality Audio coding using Psychoacoustic models - MPEG Audio coding standard. Music Production - sequence of steps in a bowed string instrument - Frequency response measurement of the bridge of a violin. Audio Data bases and applications - Content based retrieval.

Text books

1.*Rabiner L.R. & Schafer R.W*., Digital Processing of Speech Signals, Prentice Hall Inc.

References

2.*O'Shaughnessy, D*. Speech Communication, Human and Machine. Addison-Wesley.
3.*Thomas F. Quatieri*, Discrete-time Speech Signal Processing: Principles and Practice
Prentice Hall, Signal Processing Series.
4.*Rabiner L.R. & Gold*, Theory and Applications of Digital Signal Processing, PrenticeHall of India
5. *Jayant, N. S. and P. Noll*. Digital Coding of Waveforms: Principles and Applications to Speech and Video. Signal Processing Series, Englewood Cliffs: Prentice-Hall

ELECTIVE

DIP624E	**DSP APPLICATIONS FOR MULTIMEDIA**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT-I

Multimedia Data Representations

Basics of Digital Audio - Digitization of Sound, Typical Audio Formats (.au, .wav) Introduction to MIDI.**Graphic/Image File Formats -** Graphic/Image Data Structures. Standard System Independent Formats (GIF, JPEG, TIFF, PNG, PS, EPS). System Dependent Formats (XBM, BMP).**Color in Image and Video** :- Basics of Color. Human visual system, Rods and Cones. Color Models in Images (RGB, CMY). Color Models in Video (RGB, YUV, YCrCb).**Basics of Video** :- Types of Color Video Signals, Analog Video, Digital Video

UNIT-II

Basics of Signal Compression

Lossless Compression Algorithms - Basics of Information Theory.Huffman Coding.Adaptive Huffman Coding.Lempel-Ziv-Welch Algorithm.**Lossy Image Compression** –Overview of JPEG. JPEG 2000

UNIT-III

Video Compression

Fundamentals of Lossy Video Compression - Intra Frame and Inter Frame redundancy.Motion estimation techniques. Motion compensation.Intra Frame Prediction.Fasteralgorithms for motion estimation.De-blocking.Rate Control.**Overview of Video**

Standards – MPEG video standards, Video Teleconferencing Standards.

Module IV

Audio Compression

Simple Audio Compression Methods.Psychoacoustics.**Overview of Audio Standards** -MPEG, AAC, AC3.

Text Books

1. *V. Bhaskaran and K. Konstantinides*, "Image and Video Compression Standards: Algorithms and Architectures", 2nd ed., *Kluwer Academic Publishers*, 1997.
2. *Steinmetz, Ralf; Nahrstedt, Klara*, "Multimedia Fundamentals, Volume 1: Media Coding And Content Processing", Pearson Education India, 2002
3. *Keith Jack*, "Video Demystified: A Handbook for the Digital Engineer", 4th ed, Newnes, 2004.
5. *Symes, Peter D*, "Video Compression Demystified", McGraw-Hill, 2001.

ELECTIVE

		L	T	P	M
DIP625E	**DIGITAL COMPRESSION TECHNIQUES**	**4**	**0**	**0**	**100**

UNIT-1

Information theoretic foundations

Lossless and lossycompression,Modeling and coding
Entropy, conditional entropy, information, channels
Data models: static and adaptive
Coding: Fano, Huffman, Golomb, Rice, Tunstall

Arithmetic coding

Encoding
Decoding
Adapatation

Dictionary techniques

Static techniques
Adaptive coding: the LZ family

Context modeling

PPM
Burrows-Wheeler
Move-to-front
DMC

UNIT-II

Lossless image compression

Multiresolution
CCITT Group 3 and 4
JBIG, JBIG2

Lossy coding preliminaries

Distortion
Rate distortion
Linear system models

UNIT-III

Scalar and vector quantization

Uniform and nonunformquantizers
Adaptive quantization
Lloyd-Max quantizer
LBG quantizer
Tree-structured quantizers
Trellis-coded quantization

UNIT-IV

Differential encoding

Predictive DPCM
Adaptive DPCM
Delta modulation

Transform coding

Bases, inner products, orthogonality and orthonormality
Karhunen-Loéve transform
DCT
Walsh-Hadamard transform
JPEG

Text

1. Sayood, Khalid, *Introduction to Data Compression*, 3rd Edition, Morgan Kaufmann, 2006.

References

2. Anderson, J.B. and Mohan, S., *Source and Channel Coding*, Kluwer, 1991.
2. Gersho, A. and Gray, R.M., *Vector Quantization and Signal Compression*, Kluwer, 1992.
3. Netravali, A.N., *Digital Pictures, Representation and Compression*, Plenum, 1989.

ELECTIVE

DIP 626E	**EMBEDDED SYSTEMS**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT-I

Introduction

Challenges of Embedded Systems – fundamental components – examples of embedded systems – hardware fundamentals – gates – timing diagrams – memory – direct memory access – buses – interrupts – schematics – build process of embedded systems. **Memory**

UNIT-II

Management and Interrupts

Memory access procedure – types of memory – memory management methods – Pointer related issues – polling versus interrupts – types of interrupts – interrupt latency – re-entrancy – interrupt priority – programmable interrupt controllers – interrupt service routines.

UNIT-III

Real-Time Operating Systems – RTOS

Desktop Operating Systems versus RTOS – need for Board Support Packages – task management – race conditions – priority inversion – scheduling – inter task communication – timers – semaphores – queues.

UNIT-IV

Embedded System Design and Implementation

Requirements of an embedded system – architecture styles and patterns – design practices – implementation aspects and choices.

Embedded Software Development Tools

Host and target machines – cross compilers – linker and locators for embedded software – address resolution – locating program components – initialized data and constant strings – PROM programmers – ROM emulators – Flash memory.

Text books:

1. SriramV.Iyer, Pankaj Gupta, "Embedded Real-time Systems Programming", Tata McGraw Hill publishers, 2004.

2. David E.Simon, "An Embedded Software Primer", Pearson Education publishers, 1999.

References:

1. Raj Kamal, "Embedded Systems" Tata McGraw Hill.
2. A unified Hardware/Software Introduction, "Embedded System Design "Frank Vahid and Tony Givargis, John Wiley & Sons publishers, 2002.

ELECTIVE

DIP627E	**REAL TIME SYSTEMS**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT – I
Typical Real-Time applications, Hard versus Soft Real-Time systems, A reference model of Real-
Time Systems.

UNIT – II
Commonly used approaches to Real-Time scheduling, Clock-Driven scheduling, Pros and Cons of
Clock-driven scheduling.

UNIT – III
Priority-Driven scheduling of Periodic tasks: static assumption, Fixed-Priority versus Dynamic-
Priority algorithms, Optimality of the RM and DM algorithms, Aschedulability test for Fixed-Priority tasks with short response times and arbitrary response times, sufficient schedulability
conditions for the RM and DM algorithms;
Scheduling Aperiodic and Sporadic jobs in priority-Driven systems: Deferrable Servers, Sporadic
Servers, Constant Utilization, Total Bandwidth and weighted Fair-Queuing Servers, Scheduling
of sporadic Jobs.

UNIT – IV
Resources and Resources Access Control, Scheduling Flexible computations and tasks with temporal distance constraints.

Text book:
Jane W.S.Liu, 'Real-Time Systems', Pearson Education Asia.

Reference books:
C.M.Krishna and G.Shin, 'Real-Time Systems', Tata McGraw Hill Co. Inc., 1997.

ELECTIVE

DIP628E	**BIOINFORMATICS**	**L**	**T**	**P**	**M**
		4	**0**	**0**	**100**

UNIT – I **(15 Periods)**

1. **Introduction**
   Definitions, Sequencing, Molecular Biology and Bioinformatics, Biological sequence/structure, Genomoe Projects, Pattern Recognition and prediction, Folding problem, Sequence Analysis, Homology and Analogy, Bioinformatics Applications, Central Dogma of Molecular Biology

2. **Information Resources**
   Biological databases, Primary Sequence databases, Protein sequence databases, Secondary databases, Protein pattern databases, and Structure classification databases DNA sequence databases, specialized genomic resources

UNIT – II **(18 Periods)**

3. **DNA Sequence Analysis**
   Importance of DNA analysis, Gene Structure and DNA sequences, Features of DNA sequence analysis, EST (Expressed Sequence Tag) searches, Gene Hunting, Profile of a cell, EST analysis, Effects of EST data on DNA databases, The Human Genome Project

4. **Pair Wise Alignment Techniques**
   Database Searching, Alphabets and complexity, algorithm and programs, comparing two sequences, sub-sequences, Identity and similarity, The Dot plot, Local and Global similarity, Different alignment techniques, Scoring Matrices, Dynamic Programming, Pair wise database searching

UNIT – III **(15 Periods)**

5. **Multiple sequence alignment & Phylogenetic Analysis**
   Definition and goal, The consensus, Computational complexity, Manual methods, Simultaneous methods, Progressive methods, Databases of Multiple alignments, and searching, Applications of Multiple Sequence alignment, Phylogenetic Analysis, Methods of Phylogenetic Analysis, Tree Evaluation, Problems in Phylogenetic analysis, Tools for Phylogenetic Analysis

6. **Secondary database Searching**
   Importance and need of secondary database searches, secondary database structure and building a sequence search protocol

UNIT – IV **(12 Periods)**

7. **Gene Expression and Microarrays**
   Introduction, DNA Microarrays, Clustering Gene Expression Profiles, Data Sources and tools, Applications

8. **Analysis Packages**
   Analysis Package structure, commercial databases, commercial software, comprehensive packages, packages specializing in DNA analysis, Intranet Packages, Internet Packages.

Text Book:

1. Introduction to Bioinformatics T K Attwood And D.J. Parry-Smith, Pearson

2. Bioinformatics methods and applications S.C. Rastogi, N. Mendiratta And

P.Rastogi., PHI

Reference Books:

1. Introduction to Bioinformatics Arthur M. Lesk OXFORD Publishers (Indian Edition)
2. Elementary Bioinformatics, ImtiyazAlam Khan, Pharma Book Syndicate