COURSE STRUCTURE FOR

M.E.(Electronics & Telecommunication) Signal Processing
(w.e.f.June-2008)

SEMESTER – I

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
	Linear Algebra & Random Processes	3	-	100	-	-	-	100	3
	Principles and Practices for IT Management	3		100		-	-	100	3
	Signal Processing Techniques	3	-	100	-	-	-	100	3
	Elective-I	3	-	100	-	-	-	100	3
	Elective-II	3	-	100		-	-	100	3
	Signal Processing Lab-I	-	6	-	50	-	-	50	3
	Seminar I		4	-	50	-	-	50	2
Total of First Term		**15**	**10**	**500**	**100**	**-**		**600**	**20**

SEMISTER – II

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
	Statistical Signal Processing	3	-	100	-	-	-	100	3
	Advanced Digital Signal Processing	3		100		-	-	100	3
	VLSI in Signal Processing	3	-	100	-	-	-	100	3
	Elective-III	3	-	100	-	-	-	100	3
	Elective-IV	3	-	100		-	-	100	3
	Signal Processing Lab-II	-	6	-	50	-	-	50	3
	Seminar-II		4	-	50	-	-	50	2
Total of Second Term		**15**	**10**	**500**	**100**	**-**		**600**	**20**

SEMISTER – III

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
	Seminar III		4	-	50		-	50	2
	Project-Phase I	-	18	-	50		-	50	6
Total of Third Term			**22**	**-**	**100**			**100**	**8**

SEMISTER – IV

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
	Project-Phase II	-	18	-	150*	50	-	200	12
Total of Fourth Term			**18**	**-**	**150**	**50**		**200**	**12**

- The Term Work of Project stage II of semester IV should be assessed jointly by the pair of internal and external examiners. Along with the oral examination of the same.
- Note :- The contact hours for the calculation of load of teacher.

  Seminar – 1 Hr / week / student &
  Project – 2 Hr / week / student

Elective I

a) Digital Image Processing
b) Automotive Electronics
c) Artificial Intelligence

Elective II

a) Biomedical Signal Processing
b) Wireless and Mobile Communication
c) Smart Antennas

Elective III

a) Acoustic & Speech Processing
b) Digital Signal Compression
c) Multimedia Techniques

Elective IV

a) Radar & Satellite Signal Processing
b) Operating Systems & Open Source Systems
c) Computer Vision

Syllabus details of subjects

Semester – I

Linear Algebra and Random Processes

Vectors-Linear independence, Vector space
Matrices – Inverse, transpose, Determinant, Rank, trace, Linear operators, Linear equations, eigen values & vectors, Decomposition theorem, quadratic form, special matrix forms- Hankel, Toeplitz, Hermitian form.
Probability- sample space, conditional probability, statistical independence, bayes theorem.
Random variables - stationary process- wide sense stationary, statistical averages, probability models, ergodic processes, auto correlation, spectral representation of random signals, advanced topics in random processes, random signals and noise.

Texts/References:
1.K.Hoffman & R.Kunze, Linear Algebra- PHI, 1996
2.S.Andrilli & D.Hecker-Elementary linear Algetra-Else verinc 2003.
3.A. Popoulis & U.Pillai-Probability, Random Uariables & stochastic processors-TMH, 2004.
4.H.Stark& J.W.Woods-Probability, Random variables & eitimation theory for Engineer PHI-1994.

Signal Processing Techniques

Introduction to signals and systems- sampling theorem, sampling of Bandpass signals,
Introduction to DSP- Z-transform, DFT, FFT.
Filter design - FIR, Methods- window, frequency sampling, equiripple / Remaze algorithm. IIR filter- methods- impulsive invariance, bilinear Z-transform, approximation of derivative, FIR & IIR filter structure

Texts/References:
1. John G. Proakis, Oimitris G. Manolakis-Digital Signal Processing-Principles, algorithms & applications, PHI,1997.
2. S.K.Mitra ,Digital Signal Processins- TMH, 1998.
3. A.V.Oppenheim & R.W.Schafer ; Diserete time signal processing-PHI,1997.
4. L.R.Rabiner & R.W.Schafer -Digital processing of speech signals-PHI,1978.

Elective- I

a) Digital Image Processing

Digital image fundamentals: representation - elements of visual perception - simple image formation model - Image sampling and quantization - basic relationships between pixels - imaging geometry.
Image transforms: 2D-DFT, FFT, KL , Hadamard , DCT and W avelet transforms. Image enhancement: Spatial domain methods: point processing - intensity transformations, histogram processing, image subtraction, image averaging; Spatial filtering- smoothing filters, sharpening filters. Frequency domain methods: low pass filtering, high pass filtering, homomorphic filtering. Generation of spatial masks from frequency domain specifications.
Image restoration: Degradation model - Diagonalization of circulant and Block circulant matrices - Algebraic approaches- Inverse filtering - W iener filter - Constrained Least squares restoration –
Geometric transformations. Fundamentals of Colour image processing: colour models - RGB, CMY, YIQ, HIS - Pseudo color image processing - intensity slicing, gray level to color transformation.
Image compression: fundamentals- redundancy: coding, inter pixel, psychovisual, fidelity criteria, Models, Elements of information theory, Error free compression- variable length, bit plane, lossless predictive, Lossy compression- lossy predictive, transform coding. Fundamentals of JPEG, MPEG, Fractals.
Image segmentation: Detection of discontinuities - point, line and edge and combined detection ; Edge linking and boundary description - local and global processing using Hough transform Thresholding - Region oriented segmentation - basic formulation, region growing by pixel aggregation, region splitting and merging - Use of motion in segmentation. Fundamentals of Representation and Description.

Texts/References:

1. Gonzalez and Woods, "Digital Image Processing", Pearson Education,
2. Anil K. Jain "Fundamentals of Digital Image Processing", Pearson Education
3. Mark Nelson, Jean- Loup Gailly "The Data compression Book" bpb Publications.
4. Pratt William K.,"Digital Image Processing", John Wiley & sons

b) Automotive Electronics

Introduction to Automative Systems –Starting Systems, ignition Systems, Engine Cooling System etc.
Electronic sensors used in Automative - speed, pressure, flow, Temperature, positioning sensors, Range, Advanced sensors such as MEMS, Vision sensors
Electronic Control Systems - Engine control, Ignition Control, Brake control, cruise control, Wiper control, etc.
Electronic safety systems - Collision detection, Night Vision, Vehicle detection, traffic Lane detection etc, intelligent braking.

Texts/References:
Automative Electronics Handbook , Ronald Jurgen, Mc-Graw Hill publications
Advanced Microsystems for Automative Applications 2005", Springer publications, Wolfgang Gessner.

c) Artificial Intelligence

Overview: foundations, scope, problems, and approaches of AI.
Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents Artificial Intelligence programming techniques
Problem-solving through Search: forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications.
Knowledge Representation and Reasoning: ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications.
Planning: planning as search, partial order planning, construction and use of planning graphs
Representing and Reasoning with Uncertain Knowledge: probability, connection to logic, independence, Bayes rule, bayesian networks, probabilistic inference, sample applications.
Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications.
Machine Learning and Knowledge Acquisition: learning from memorization, examples, explanation, and exploration. learning nearest neighbor, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications.
Brief Survey of selected additional topics: perception, communication, interaction, and action; multiagent systems.

Texts/References:

1. Artificial Intelligence: A Modern Approach, 2nd Edition, by Stuart Russell and Peter Norvig.
2. T. Dean, J. Allen, Y. Aloimonos. "Artificial Intelligence: Theory and Practice" The Benjamin/Cummings Publishing Company, Inc.
3. B. L. Webber, N. J. Nilsson, eds. "Readings in Artificial Intelligence" Tioga Publishing Company,
4. Patrick H. Winston. "Artificial Intelligence" 3rd edition Addison Wesley.
5. E. Rich and K. Knight. "Artificial Intelligence" Second edition McGraw Hill.

Elective-II

a) Biomedical Signal Processing

Introduction: cell structure, basic cell function, origin of bio-potentials, electric activity of cells.
Biotransducers: Physiological parameters and suitable transducers for its measurements, operating principles and specifications for the transducers to measure parameters like blood flow, blood pressure, electrode sensor, temperature, displacement transducers.
Cardiovascular system: Heart structure, cardiac cycle, **ECG** (electrocardiogram) theory (B.D.), **PCG** (phonocardiogram).**EEG, X-Ray, Sonography, CT-Scan**,The nature of biomedical signals.
Analog signal processing of Biosignals, Amplifiers, Transient Protection, Interference Reduction, Movement Artifact Circuits, Active filters, Rate Measurement. Averaging and Integrator Circuits, Transient Protection circuits.

Introduction to time-frequency representations- e.g. short-time Fourier transform, spectrogram , wavelet signal decomposition.
Biomedical applications: Fourier, Laplace and z-transforms, autocorrelation, cross-correlation, power spectral density.
Different sources of noise, Noise removal and signal compensation.
Software based medical signal detection and pattern recognition.

Texts/References:

1. Handbook of Biomedical Instrumentation,second edition,R S Kandpur,TMH Publication,2003
2. E. N. Bruce, Biomedical signal processing and signal modelling, New York: John Wiley, 2001.
3. Wills J. Tompkins, biomedical digital signal processing, PHI.
4. M. Akay, Time frequency and wavelets in biomedical signal processing, Piscataway, NJ: IEEE Press, 1998.
5. Biomedical instrumentation and measurements by Cromwell, 2nd edition, Pearson education.

b)Wireless and Mobile Communication

Overview of Wireless and Mobile communications - Cellular System concepts, Frequency Reuse, Handoff strategies, Co-channel and adjacent channel interference, Improving Coverage, Generations-2G,2.5G,3G,4G.
Wireless Channel Characterization- Reflection, Diffraction, Scattering, small scale multipath propogation and its effects
Equalization, Diversity and Channel coding techniques
Antennas used for Mobile communication- Base station and mobile unit antennas
Wireless systems and Standards- **GSM** – Architecture, channels,frame, signal processing. **IS-95** – Frequency and channel specification, forward and reverse CDMA channel. Introduction to **IS-2000.**

Texts/References:

1.Theodore S. Rappaport – Wireless Communication- Principles & practice.PHI-2006.
2. William C.Y.Lee -Mobile Cellular Telecommunication – Analog & Digital Systems, Mc Graw- Hill Inc 1989
3. David Tse, Pramod Viswanath- Fundamental of Wireless communication- Cambridge University Press- 2006
4. Clint Smith, Daniel Collins- 3G Wireless networks, Tata Mc Graw Hill 2007.

c) Smart Antennas

Introduction to Array Antennas: Basic Array characteristics, Linear Arrays- Patterns, Beamwidth, Sidelobes, grating lobes, bandwidth, planar Arrays- Array coordinates, beamwidth, grating lobes

Adaptive Array Fundamentals :- Antenna Null Rotation, Electronic Null Steering , Constrained Power minimization, Weak Signal Adaptation, Sidelobe canceller, the Davies Beamformer, Multiple Null Formation
Vector and Matrix techniques for Adaptive Arrays : Narrow Band Signals , Vector Inner Products, Angles Between Vectors, Orthogonality achieved by projections, output powers, covariance Matrices, Quadratic Forms
Optimal Antennas : Meaning of optimality, Eigen value, Solution for maximum SNIR, Least Mean Square (LMS) Error Criterion, Maximization Of Probability of Detection, Direct maximization of SNR, Optimization of power pattern
Adaptive Solutions of optimal Antennas: Meaning of Adaptivity, Gradient Methods, Real Time Least Mean square Error Algorithm.

Texts/References:

1. Adaptive Array Principles, J.E. Hudson, Peter Peregrinus Ltd, On Behalf of Institution of Electrical Engineers, London New York.
2. Adaptive Antennas, Concepts and Performance, By R.T Compton, JR, Prentice Hall, New Jersey
3. Practical Phased Array Antenna Systems, By Eli Brookner – Editor Artech House, Boston ,London
4. Phased Array Antennas, By R.C. Hansen, Wiley Series in Microwave and optical Engg, John Wiley & Sons Inc, Wiley- Interscience Publication
5. Signal Processing Arrays, By The Advisory Group for Aerospace Research & Development NATO, Editor- W.T. Blackband, Published By : Technivision Services, Maidenhead, England, A Division of Engelhard Hanovia International Ltd.
6. Introduction to Adaptive Arrays, R. A. Monzingo and TW Miller, Wiley.
7. Adaptive Signal Processing, By B Widrow and SD Stearns, Prentice Hall.
8. Advanced Antenna Technology, Edited by P.J.B. Clarricoats, Microwave Exhibitions and Publishers Ltd ,UK

Semester – II

Statistical Signal Processing:

Signal modeling - least square method, pade approximation, prony's method - linear prediction, Applications. FIR least squares Inverse filters, finite data records, stochastic models.
Levinson-Durbin Recursion- The lattice filter, Levinson Recursion, split Levinson Recursion.
Wiener filtering- FIR & IIR Wiener filter , discrete Kalman filter.
Spectrum estimation - Non parametric methods, minimum variance spectrum estimation, maximum entropy method, parametric method.

Texts/References:

1. Monson Hayes - Statistical Digital signal processing and modeling ; John Wiley, & sons 1996.
2. D.G. Manolakis, V.K.Ingle, S.M.Kogon -Statistical & Adaptive Signal Processing-Mc GrawHill, 2000.
3. Simon Haykin- Adaptive Filter Theory PHI, 1996.
4. S.M. Kay-Modern Spectral Estimation- PHI, 1987.

Advanced Digital Signal Processing

Multirate DSP-Decimation, interpolation, non-integer multirate processing
Filter design- polyphase filter structure, multistage implementation of sampling rate conversion, sampling rate conversion of band pass signals by an arbitrary factor, applications of multirate signal processing
Least square method for system modeling & filter design- Prediction and deconvolution, solution of least square estimation problems
Adaptive filters- applications, direct form FIR filters, Lattice- ladder filter, LMS based, gradient adaptive lattice filter, adaptive beam forming,
Application to radar, sonar, geo physics and hydrology
DSP processor-Harvard architecture, TMS-320C 54xx, ADSP 21XX, implementation of FIR, IIR Decimation, interpolation algorithm.

Texts/References:

1. Proakis-Advanced Digital Signal Processing Macmillan publishing company,1992.
2. S.Haykins-Adaptive filter Theory, Printice Hall, 1986.
3. P.Vidyanathan-Multirate signal Processing,
4. Avtarsingh & S.Srinivasan-Disital Signal Processing

VLSI in Signal Processing

Typical DSP algorithms and representation : DCT, DWT and filter banks, Vector Quantization, Block diagram, signal flow graph, data flow graph and dependence graph. DSP application demands and CMOS technologies, Loop bound and iteration bound and their computation

Pipelining and Parallel Processing: Pipelining of FIR Digital filters, parallel FIR digital filters, combined pipelining and parallel processing. Retiming, Properties of retiming, Retiming techniques for clock minimization and register minimization. Unfolding, properties and applications of unfolding. Folding, 2D Systolic arrays and matrix multiplication.

Bit level arithmetic architectures: Parallel multipliers, Baugh Wooley carry save multiplier, Booth Wallace Tree multipliers, Bit serial multipliers, Bit serial FIR filter. Carry free radix-2 addition and substraction, Floating point arithmetic.

Clocking for synchronous pipelining and wave pipelining systems: Clock distribution, Floor planning. FPGA architecutures: block memories, CLBs, IOBs, Routing resources, specific resources like MAC, DLL, clock managers etc.

Texts/References:

1. "VLSI Digital Signal Processing Systems, Design and Implementation" by KEshab Parhi, John-Wiley & sons.
2. "Principles of CMOS VLSI Design", by Neil H.E.Weste, Kamran Eshraghian, Pearson Education.
3. "Digital Systems Desoign Using VHDL", by Charles Roth, Jr. Thomas Learning.
4. "Design Warriors guide to FPGAs" by C.M Maxfield, Newness
5. "Digital Signal Processing with Field Programmable Gate Arrays", U.Meyer-Baese, second edition Springer.

Elective III

a) Acoustics and Speech Processing

Sound signal processing: introduction to acoustic signal Processing, instruments-microphone, microphone balance, monitoring and control (noise, hum, distortion, crosstalk, fades), volume and dynamics (dynamic range, compression), filters, graphic equalizers, artificial reverberation (absorption co-oefficient, echo chamber, delay effect etc.), mixers. Studio design.

Acoustic measurements: acoustic parameters, reciprocity calibration, directivity, particle velocity, intensity, speed of sound, acoustic impedance, attenuation.

Acoustic MIMO signal processing: signal models, characteristics of acoustic channels, measurements and simulation of MIMO acoustic systems.

The speech communication pathway- discrete-time speech signal processing overview (B.D.), physiology of speech production, speech perception (acoustic cues, models of speech perception)
Speech signal analysis- Introduction, ADC conversion, feature extraction, cepstrum analysis, distortion measures, implementation of HMM (Hidden Markov Model), Implementation issues.

Texts/References:

1. "The Sound Studio",5th Edition , Alec Nisbett
2 "Acoustic Waves And Oscillations",S.N. Sen
3" Introduction To Acoustics",Robert D. Finch,PHI
4 "Acostic MIMO Signal Processing" Huang Yeteng and Benesty by Springer
5 "Speech And Audio Signal Processing",Bengold And Nelson Morgan,Willey
6 "Digital Processing Of Speech Signals",L.R. Rabiner,R.W.Schafer",Pearson Education.
7 "Speech Recognition,Theory And C++ Implementation",Claudio Becchetti And Lucio Prina Ricotti",John Wiley And Sons,2004.

b) **Digital signal compression**

Data Compression : Entropy coding-Huffmann Run length, arithmetic and Ziv-Lempel coding.
Speech & Image waveform characterization-source models, quantization, optimal & adaptive waveform coders for speech & images.
Predictive coding-DPCM, Linear prediction, prediction for video, adaptive prediction, motion compensation for video.
Transform coding: Orthogonal transforms-Fourier, cosine, wavelet based approaches to speech & image compression.
Subband coding- VQ based compression, Fractal coding of images. High quality video & audio compression for digital broadcasting.
Standards for digital signal compression-data, speech, audio, image & video.

Texts/References:

1. Jayant & Noll, " Digital coding of waveforms-Principles and Applications to speech & video",PH, 1984.
2. Saeed V. Vaseghi , " Multimedia signal processing" Wiley Publication 2007
3. Iain E.G. Richardson, "H.264 & MPEG 4 Video Compression" , Wiley Pub.

c) Multimedia Techniques

Introduction- Overview, Concept of Multimedia, Multimedia Applications, Hardware Software requirements, Multimedia building block, Steps of creating Multimedia.
Text- Types, Unicode Standards, Compression, Font, Layouts, HTML, CSS, Multimedia Documents, Hypertext, Hypermedia.

Graphics- Vector and Bitmapped, Resolution, Color and other Color Models, Light, graphic file formats; basic graphic editing techniques: selection, cut, copy, paste, layers effects, repositioning for the Web, Image Compression techniques.
Multimedia Audio- Basic sound concepts, Elements of sound processing, audio capture, music, speech sound processor, sound recovery technique, VOC4WAV file formats for sound. MIDI, combing sound and pictures.
Multimedia Video-basics of video, video capture animation video, Processing, video recovery techniques, AVO, AVI file formats.
Animation- Introduction, Background, uses, types, 3D animation, motion graphics, virtual reality, Flash.

Texts/References:

1. Ranjan Parekh, Principles of Multimedia, Tata Mcgraw Hills
2. Nigel Chapman, Digital Multimedia, Wiley, 2nd Edition.
3. Ralf Steinmetz, Klara Nahrstedt, Multimedia: Computing, Communication and applications PH-PTR Innovative technology series.
4. Judith Jefcoate, Multimedia in Practice: Technology and Application PHI 1998.
5. Durano R Begault, Virual Reality and Multimedia, AP Professionals.
6. Micheal J Young, Windows multimedia and animation with C++ programming for Win95, AP Professional.
7. Kris Jama, Phil Schmauder, nelson Yee, VRML Programmer's Library, Galgotia
8. Joe Gradicki, Virtual reality Construction Kit, Jhon Wile & Sons Inc.

Elective IV

a) Radar and Satellite Signal processing:-

Radar Fundamentals : Introduction, Radar principles, Target Information Extraction, Radar Equation, Introduction to signals and Signal Processing in Radars, Types of radars
Radar Signal Processing: Fundamentals and Definitions as applied to Radars Signal Integration, correlation, convolution, spectrum Analysis, FFT, Fast Convolution, Fast correlation, Processing Errors and Windows, Windows and Resolution, Recovery from Samples- Interpolation, Digital Filters.
MTI and Doppler Processing : MTI Fundamentals, Principles and Methods, Blind Doppler Shifts and PRF Stagger, Destaggering and Processing, MTI and MTD with moving radars and moving clutter.
Introduction to Satellite communication: Satellite communication Concepts, Applications, Advantages and Disadvantages.
Signal Processing: Introduction, Transmission of Analogue Signals , SC PC/ FM, FDM/ FM,SCPC/ FM Television, Transmission of Digital Signals, Digital modulation Techniques, BPSK, QPSK,MSK
Error Performance of Digital modulation Techniques- Error Rate performance with channel Encoding, Performance objectives, spectral efficiency.

Texts/References:

1. Radar – Principles, Technology, Applications By Byron Edde, Pearson education Low price Edition
2. Radar Design Principles- Signal Processing and the Environment. By Fred. E. Nathanson, Prentice Hall of India Pvt Ltd
3. Introduction to Radar Systems By Merrill .I. Skolnik, Tata McGraw Hill Publishing Co Ltd
4. Satellite Communications Technology By Robert .L. Douglas, Prentice Hall , New Jersey.
5. Satellite Communication Systems, By G. Maral and M Bousquet John Wiley & sons.
6. Communication Satellites in the Geostationary orbit, By Donald M Jansky and Michel C Jeruchim Artech House Inc.
7. World Satellite communications and Earth Station Design, by Brian Ackroyd. BSP Professional Books, Oxford, London Edinburgh
8. Satellite communications, Edited by Harry L. Van Trees, IEEE Press
9. Satellite Communication, By Timothy Pratt and Charles W. Bostian, John Wiley & Sons
10. Satellite Communications, By Robert M Gagliardi, CBS Publishers & Distributors, Delhi

b) Operating Systems and Open Source Systems

Concepts of operating systems : File Management, Internal representation of files, Directory structures, Process Management, Process scheduling, Inter process communication and synchronization, Critical Sections, Deadlock handling, Memory Management policies, Swapping, Demand Paging, Virtual Memory Management, Secondary Memory Management, Disk Scheduling, I/O subsystem, Device Drivers. Distributed Operating Systems, Protection and Security.

Open Source Operating Systems : Architectures and internals of open source based operating systems, including Linux, OpenSolaris and OS X, virtualization technologies, performance issues.

Texts/References:

1. Silberschatz, Galvin "Operating System Concepts" 6/e , John Wiley & Sons, ISBN-9971-51-388-9
2. Dhamdhre D. M.,"Operating Systems – A Concept-Based Approach", Tata McGraw Hill Publications, 2nd Edition-2006
3. Andrew S. Tanenbaum, " Modern Operating Systems", 2/e, Prentice Hall India, ISBN-81-203-2063-8
4. P.K. Sinha : "Distributed Operating Systems : Concepts and Design", IEEE Comp. Soc. Press, 1997.

c) **Computer Vision**

Introduction- purpose, state of the art
Image Formation - image sensors , projection, color
Geometric Calibration- interior and exterior calibration, rectification
Stereo imaging and motion- epipolar geometry, correspondence, triangulation , detection and tracking of point features, optical flow Object Tracking Kalman filter, condensation, tracking humans Object Tracking Kalman filter, condensation, tracking humans.
Non-visible-light Imagery- processing of non visible light images and depth images
Applications of computer vision - Fingerprint or iris recognition system , tomography , automatic reading of license plates , Industrial robot vision etc

Texts/References:

1. Ballard and Brown. "Computer Vision." Prentice Hall.
2. Forsyth and Ponce, Computer Vision: A Modern Approach, Prentice Hall