M.TECH- REMOTE SENSING AND WIRELESS SENSOR NETWORKS

CENTRE FOR EXCELLENCE IN COMPUTATIONAL ENGINEERING & NETWORKING

Earth observation from space has provided mankind and its decision makers with new global perspective of its environment. Protection of the environment will certainly be one of the greatest challenges in the 21st century. Remote sensing data gathered from air borne and space borne sensor systems are one of the starting points for preparing tools for gaining a better understanding of its complex interactions between the atmosphere, oceans, ice regions and land surfaces on one hand and the population with its various activities on the other hand. Recent developments in sensor technology coupled with wireless network technology have given a new dimension to the word 'remote sensing'. Remote sensing by deployment of thousands of sensors in fields to gather data for remote monitoring, control or other decision making process can now be put under the purview of remote sensing. There are immense possibilities for integrating data obtained from satellite based sensing and ground based measurements using cheap sensors deployed in the field. This course aims at developing manpower in this highly interdisciplinary area. The forecast for such manpower requirements is large and fall short of the current requirements. Remote sensing and wireless sensor networks as a scientific discipline, depends on field measurements, computer vision, adhoc wireless networks (now called IOT) , analysis and cognition systems.

It is truly a DATA SCIENCE and getting more and more integrated with scientific computing and AI(Artificial intelligence).

It has great strategic importance from the point of view of defense, natural calamities, space exploration and non-destructive testing. It is also applied in agriculture, marine and geological explorations, weaponry, transportation and health monitoring of machines, structures and livestock. Centre has added, DRONE based multispectral imaging lab. It has also added a DNA sequencing lab. These two exponentially growing technologies have huge potential for doing bio-surveillance of the Earth.

The basic course starts with a strong foundation in mathematics. It is strengthened by courses in remote sensing (for spatio temporal data analytics), image processing, pattern recognition and specific courses on sensor technology, wireless networking (IOT) and geographical information systems.

Note: Curriculum take into account the fact that, Remote sensing, in modern technical term, is multidisciplinary data science which is getting enhanced with modern AI and Scientific computing. It requires strong foundation in Mathematics and statistics. So the strategy used in the choice and schedule of the subjects is that "give strong foundation in common core and foundational subjects in the first two semesters and allow them to master an area of his/her choice through four electives, one minor and one major project. So 50% of the weightage is for building foundation and remaining 50 % for specialization.

CURRICULUM

First Semester

Course Code	Type	Course	L T P	Credits
18MA607	FC	Computational Linear Algebra and Optimization for Data Sciences	3 0 1	4
18CN621	SC	Introduction to Machine Learning	2 0 1	3
18CN601	FC	Algorithms and Structures for Data Science	2 0 1	3
18RW621	SC	Fundamentals of Spatio-Temporal Data Analytics	2 0 1	3
18CN623	SC	Embedding Computing for Data Science	2 0 1	3
18RM600	SC	Research Methodology	2 0 0	2
18HU601	HU	Amrita Values Program*		P/F
18HU602	HU	Career Competency-I *		P/F
			Credits	**18**

*Non-Credit Course

Second Semester

Course Code	Type	Course	L T P	Credits
18CN624	SC	Machine Learning for Signal Processing and Pattern Classification	2 0 1	3
18CN602	FC	Deep Learning and Probabilistic Graphical Models	2 0 1	3
18CN625	SC	Scientific Computing	2 0 1	3
18CN626	SC	Computer Networks and IoT	2 0 1	3
	E	Elective-I	2 0 1	3
	E	Elective-II	2 0 1	3
18HU603	HU	Career Competency-II	0 0 2	1
			Credits	**19**

Third Semester

Course Code	Type	Course	L T P	Credits
18CN627	SC	Big Data Framework for Data Science	2 0 1	3
	E	Elective-III	2 0 1	3
	E	Elective-IV	2 0 1	3
18RW798	P	Dissertation		8
		Credits		**17**

Fourth Semester

Course Code	Type	Course	L T P	Credits
18RW799	P	Dissertation		12
			Credits	**12**

Total Credits:66

List of Courses

Foundation Core

Course Code	Course	L T P	Credits
18MA607	Computational Linear Algebra and Optimization for Data Sciences	3 0 1	4
18CN601	Algorithms and Structures for Data Science	2 0 1	3
18CN602	Deep Learning and Probabilistic Graphical Models	2 0 1	3

Subject Core

Course Code	Course	L T P	Credits
18CN621	Introduction to Machine Learning	2 0 1	3
18RW621	Fundamentals of Spatio-Temporal Data Analytics	2 0 1	3
18CN623	Embedding Computing for Data Science	2 0 1	3
18CN624	Machine Learning for Signal Processing and Pattern Classification	2 0 1	3
18CN625	Scientific Computing	2 0 1	3
18CN626	Computer Networks and IoT	2 0 1	3
18CN627	Big Data Framework for Data Science	2 0 1	3
18RM600	Research Methodology	2 0 0	2

Course Electives

Students are allowed to choose the electives offered under M.Tech CEN.

Course Code	Course	L T P	Credits
18RW701	Guidance, Navigation and Control: Theory and Applications	3 0 0	3
18RW702	Geographical Information Systems: Principles and Applications	2 0 1	3
18RW703	Fundamentals of Synthetic Aperture Radar Signal Processing	3 0 0	3
18RW704	Space-Time Adaptive Processing: Application to Radar	2 0 1	3
18RW705	Principles of Satellite Navigation	3 0 0	3
18RW706	Satellite Remote Sensing Astrodynamics	3 0 0	3
18RW707	Hyperspectral Imaging Systems	2 0 1	3
18RW708	Practical GIS	0 0 3	3
18RW709	Vehicular Communication, Navigation and Control	2 0 1	3
18RW710	Microwave Remote Sensing	3 0 0	3
18RW711	LIDAR	3 0 0	3
18RW712	Gravitational Wave Remote Sensing	3 0 0	3
18RW713	Acoustic Remote Sensing	3 0 0	3

18RW714	Remote Sensing using Magnetic Fields	3 0 0	3
18RW715	RF Antenna Systems	3 0 0	3
18RW716	Geospatial Intelligence	3 0 0	3
18RW717	Geo Analytics	3 0 0	3
18RW718	Deep Space Remote Sensing	3 0 0	3
18RW719	Geospatial Technologies for Urban Planning	3 0 0	3
18RW720	Aerial Photography and Photogrammetry	3 0 0	3
18RW721	Geospatial Applications for Agriculture and Forestry	3 0 0	3
18RW722	Geospatial Applications for Oceanography	3 0 0	3
18RW723	Statistical and Adaptive Signal Processing	2 0 1	3
18RW724	Digital Control System	2 0 1	3
18RW725	Data Communications & Computer Networks	2 0 1	3
18RW726	Hardware Software Co-Design	2 0 1	3
18RW727	DSP Processors and Architecture	2 0 1	3
18RW728	Live-in-Lab	2 0 1	3

18MA607 COMPUTATIONAL LINEAR ALGEBRA AND OPTIMIZATION FOR DATA SCIENCES 3-0-1-4

Matrices and Gaussian Elimination – Introduction, Geometry of Linear Equations, Gaussian Elimination, Matrix multiplication, Inverses and Transposes, Special matrices and applications. Vector spaces and Linear equations– Vector spaces and subspaces, linear independence, basis and dimension, the four fundamental subspaces. Orthogonality - Perpendicular vectors and orthogonal subspaces, inner products and projections onto lines, projections and least square applications, orthogonal basis, orthogonal spaces, orthogonal matrices, Gram Schmidt orthogonalization, FFT. Eigenvalues and Eigenvectors – Introduction, diagonal form of a matrix, difference equations and the powers of A^k, Positive Definite Matrices - Minima, Maxima and saddle points, tests for positive definiteness, semi-definite and indefinite matrices, Singular Value Decomposition, iterative methods for Ax = b, applications in sparse signal and image processing.Introduction - mathematical optimization, least-squares and linear programming, convex and nonlinear optimization. Convex sets, Convex optimization problems - optimization problem in standard form, convex optimization problems, quasi-convex optimization, linear optimization, quadratic optimization, generalized inequality constraints, semi definite programming, vector optimization. Duality, Approximation and fitting, Statistical estimation, Geometric problems, Unconstrained minimization- gradient descent method, steepest descent method, Newton's method. Equality constrained minimization - equality

constrained minimization, eliminating equality constraints, Newton's method with equality constraints, infeasible start Newton method, implementation. Interior-point methods -inequality constrained minimization, logarithmic barrier function and central path, barrier method, L1 Norm Optimization methods,

Alternating direction method of multipliers (ADMM), Applications in Signal and Image Processing.

TEXT BOOKS/ REFERENCES:

1. Gilbert Strang, "*Linear Algebra and its Applications*", Third Edition, Harcourt College Publishers, 1988.
2. Gene H. Golub and V. Van Loan, "*Matrix Computations*", Third Edition, John Hopkins University Press, Baltimore, 1996.
3. David C. Lay, "*Linear Algebra and Its Applications*", Pearson Addison Wesley, 2002.
4. Stephen P. Boyd and LievenVandenberghe d, Convex Optimization, Cambridge University press, 2004
5. Kalyanmoy Deb, "*Optimization for Engineering Design Algorithms and Examples*", Prentice Hall of India, New Delhi, 2004.
6. Edwin K.P. Chong and Stanislaw H. Zak, "*An Introduction to Optimization*" Second Edition, Wiley-Interscience Series in Discrete Mathematics and Optimization, 2004.
7. M. AsgharBhatti, "*Practical Optimization Methods: With Mathematica Applications*", Springer VerlagPublishers, 2000.

18CN621 INTRODUCTION TO MACHINE LEARNING 2-0-1-3

The need for Machine Learning – Supervised learning – Unsupervised Learning – Linear regression and Feature selection – Linear Classification – Support Vector Machines – Clustering – Dimensionality Reduction – Graphical – Artificial Neural Networks – Dimensionality Reduction - Combining classifiers - regularization, clustering - Spectral clustering, Reinforcement Learning - Markov models - Large Scale Machine Learning -Applications - Introduction to Deep Learning – Deep Learning Architectures – LSTM – CNN – RNN – Hyper parameter tuning – Decision Trees – Machine Learning applied to medical data – ECG – EEG – Deep Learning applications in medical data – EEG – ECG.

TEXT BOOKS/REFERENCES:

1. Pattern Recognition and Machine Learning. Bishop, C. M. Springer (2010).
2. Introduction to Machine Learning with Python. Mueller, A. C. & Guido, S. O'REILLY' Publishers (2016).
3. Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms. Buduma, N. &Locascio, N. O'REILLY' Publishers (2017).
4. Introduction to Machine Learning, 2nd Edition. Alpaydin, E. MIT Press (2009).
5. Soman, K. P., Loganathan, R., & Ajay, V. (2009). *Machine learning with SVM and other kernel methods*. PHI Learning Pvt. Ltd.
6. EthemAlpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)‖, Third Edition, MIT Press, 2014
7. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
8. Tom M Mitchell, ―Machine Learning‖, First Edition, McGraw Hill Education, 2013.

18CN601 ALGORITHMS AND STRUCTURES FOR DATA SCIENCE 2-0-1-3

Algorithm Analysis - Methodologies for Analyzing Algorithms, Asymptotic Notation, A Quick Mathematical Review, Case Studies in Algorithm Analysis, Amortization, Experimentation .Basic Data Structures - Stacks and Queues, Vectors, Lists, and Sequences, Trees, Priority, Queues and Heaps, Dictionaries and Hash Tables.

Search Trees and Skip Lists - Ordered Dictionaries and Binary Search Trees, AVL Trees. Bounded-Depth Search Trees, Splay Trees, Skip Lists. Sorting, Sets, and Selection - Merge-Sort, Abstract Data Type, Quick-Sort, A Lower Bound on Comparison-Based Sorting, Bucket-Sort and Radix-Sort, Comparison of Sorting Algorithms, Selection. FundamentalTechniques - The Greedy Method, Divide-and-Conquer, Dynamic Programming. Graphs - Abstract Data Type Data Structures for Graphs, Graph Traversal. Directed Graphs , Weighted Graphs, Single-Source Shortest Paths, All-Pairs Shortest Paths, Minimum Spanning Trees, Network Flow and Matching, Flows and Cuts. Additional Topics- Computational Geometry, Range Trees, Priority Search Trees, Quadtrees and *k*-D Trees, the Plane Sweep Technique, Convex Hulls. NP-Completeness - P and NP, NP-Completeness, Important NP-Complete Problems.

TEXT BOOKS/ REFERENCES:

1. Michael T. Goodrich and Roberto Tamassia, "*Algorithm Design Foundations, Analysis and Internet Examples*", John Wiley and Sons, 2003.
2. Michael T. Goodrich and Roberto Tamassia, "*Data Structures and Algorithms in C++*", John Wiley and Sons, 2003.
3. Michael T. Goodrich and Roberto Tamassia, "*Data Structures and Algorithms in Java*", Fourth Edition, John Wiley and Sons, 2004.

18RW621 FUNDAMENTALS OF SPATIO-TEMPORAL DATA ANALYTICS 2-0-1-3

Basic concepts of spatio-temporal process and pattern-Sources of Errors – scene, sensor and atmospheric causes - correction: geometric and Radiometric – visual and digital interpretation-elements of interpretation – interpretation keys - digital analysis and classification – image formation, visualization : Image enhancement, filters–Baye's theorem - Image classification: unsupervised and supervised – thematic mapping - accuracy assessment-Autocorrelation-Concept of causation and experimentation vs. observational studies-Sampling designs and methods for climate change and ecology-Methods for measuring spatial structure: plotting/interpolation, point patterns, geostatistics (variograms, correlograms), Mantel tests, spectral analysis, wavelet, fractals.

TEXT BOOKS/REFERENCES:

1. Box, George EP, et al. *Time series analysis: forecasting and control*. John Wiley & Sons, 2015.

2. Barnett, Vic. *Environmental statistics: methods and applications*. John Wiley & Sons, 2005.

3. Isaaks, E. H., and R. M. Srivastava. "An introduction to applied geostatistics. Oxford Univ. Press, New York." *An introduction to applied geostatistics. Oxford Univ. Press, New York.* (1989).

4. Jolliffe, I. (2002). Principal component analysis. John Wiley & Sons, Ltd .

18CN623 EMBEDDED COMPUTING FOR DATA SCIENCE 2-0-1-3

Introduction to Embedded systems, hardware/software code sign, Embedded micro controller cores, embedded memories,Basic electronics using arduino and raspberry pi, Examples of embedded systems, sensors and interfacing techniques, Real-time concepts, real-time operating systems, Required RTOS services/capabilities (in contrast with traditional OS). Digital Systems- Design of P,

PI, and PID controllers. State space and filtering systems. Motor Controls. Communication systems- System design and simulation on simulink. Signal processing systems- Hardware based on DSP Chips and Microcontrollers, Development environments of microcontrollers and DSP processors. Software development for data acquisition, fundamentals of wireless networks for embedded system, Interfacing and Integration of microcontroller based systems. Examples of Industrial process automation, software development using python, introduction to data streams and analytics. Data visualization using python tools,Machine learning techniques on sensor data streams

TEXT BOOKS/ REFERENCES:

1. D. Gajski, F. Vahid, S. Narayan, and J. Gong."Specification and Design of Embedded Systems", PEARSON Education, 1994
2. Syaunstrup and W. Wolf. "Hardware Software Co-design: Principles and Practice", Kluwer, Academic Publishers, 1997
3. Python Programming with Raspberry Pi Paperback – Import, 28 Apr 2017
   by Sai Yamanoor and Srihari Yamanoor

18CN624 MACHINE LEARNING FOR SIGNAL PROCESSING AND PATTERN CLASSIFICATION 2-0-1-3

Introduction to real world signals - speech, image. Feature extraction and front-end signal processing - information rich representations, robustness to noise and artifacts, signal enhancement, bio inspired feature extraction. Basics of pattern recognition, Discriminative modeling - support vector machines, neural networks and back propagation. Introduction to deep learning - convolutional and recurrent networks, pre-training and practical considerations in deep learning, understanding deep networks.Clustering methods and decision trees.Applications in computer vision and speech recognition.

TEXT BOOKS/REFERENCES:

1. "Pattern Recognition and Machine Learning", C.M. Bishop, 2nd Edition, Springer, 2011.
2. "Deep Learning", I. Goodfellow, Y, Bengio, A. Courville, MIT Press, 2016.
3. "Digital Image Processing", R. C. Gonzalez, R. E. Woods, 3rd Edition, Prentice Hall, 2008.
   d. "Fundamentals of speech recognition", L. Rabiner and H. Juang, Prentice Hall, 1993.

4. “Deep Learning: Methods and Applications”, Li Deng, Microsoft Technical Report.
5. “Automatic Speech Recognition - Deep learning approach" - D. Yu, L. Deng, Springer, 2014.
6. “Computer Vision: Algorithms and Applications”, R. Szeliski, Springer, 2010.

18CN602 DEEP LEARNING AND PROBABILISTIC GRAPHICAL MODELS 2-0-1-3

Samples, Events, Event space, Probability Space, Random Variables, Independence and Conditional Independence, Conditional Probability, Joint Probability, Bayes' theorem Joint and Marginal Probability, Estimation Theory - Maximum Likelihood Estimators. Probabilistic Graphical Models: Direct and undirected model, Inference from Direct and undirected graphical model, Structured and Unstructured graphical models, Partition Function, D-Separation, Energy based models, Factor Graphs, Sampling from Graphical Models. Montecarlo Methods: Markov Chain and Montecarlo methods, Gibbs Sampling, Approximate Inference – Expectation Maximization, MAP Inference. Special cases: HMM, CRF, Kalman Filter, Deep Learning and graphical Models. .

TEXT BOOKS/ REFERENCES:

1. Koller, Daphne, and Nir Friedman. Probabilistic graphical models: principles and techniques. MIT press, 2009.
2. Ian Goodfellow, YoshuaBengio and Aaron Courville, Deep Learning, MIT press 2016

18CN625 SCIENTIFIC COMPUTING 2-0-1-3

Root finding: Functions and polynomials, zeros of a function, roots of a nonlinear equation, bracketing, bisection, secant, and Newton-Raphson methods. Interpolation, splines, polynomial fits, Chebyshev approximation. Numerical Integration and Differentiation: Evaluation of integrals, elementary analytical methods, trapezoidal and Simpson’s rules, Romberg integration, Gaussian quadrature and orthogonal polynomials, multidimensional integrals, summation of series, Euler-Maclaurin summation formula, numerical differentiation and estimation of errors. Ordinary differential equations: Lipschitz condition, solutions in closed form, power series method. Numerical methods: error analysis, stability and convergence, Euler and Runge-Kutta methods, multistep

methods, Adams-Bashforth and Adams-Moulton methods, Gear's open and closed methods, predictor-corrector methods.

Numerical solution of PDEs: relaxation methods for elliptic PDEs, Crank-Nicholson method for parabolic PDEs, Lax-Wendroff method for hyperbolic PDEs. Calculus of variations and variational techniques for PDEs, integral equations. Finite element method and finite difference time domain method, method of weighted residuals, weak and Galerkin forms, ordinary and weighted/general least squares. Fitting models to data, parameter estimation using PDEs.Iterative methods for Solution of linear matrix equations.

TEXT BOOKS/ REFERENCES:

1. Kutz, J. Nathan, Data-Driven Modeling & Scientific Computation: Methods for Complex Systems & Big Data, Oxford University press,
2. Arfken, G.B., and Weber, H.J., Mathematical Methods for Physicists, Sixth Edition, Academic Press, 2005.

18CN626 COMPUTER NETWORKS AND IOT 2-0-1-3

This course starts with the basics of computer networks and basic requirements to setup a network .The course take through discussion of current problems faced in networking and how to resolve it. The remaining portion covers the OSI Layers, Protocols, Web technologies, IOT Architectures, Introducing IOT frameworks and cloud platforms for IOT. The practical aspects of the subject will be covered through a specially made embedded board called ESP32 development board for IOT along with open source cloud platforms for data management and visualization

Introduction to computer Networks, Building a Network, Network Architecture, Implementing Network Software, Introduction to web technologies for IOT, Introduction to cloud services and platforms for IOT, Building IOT Application using ESP32 development board, Web programming and Database management, IOT application development using Arduino, Raspbery-PI and ESP32

TEXT BOOKS/ REFERENCES:

1. CISCO Semester 1 and 2,"Networking Course" Reference Material.
2. Computer networks a Systems Approach By Larry .L.Peterson and Bruce.S.Davie
3. Raspberry PI Networking Cookbook

4. An Introduction to Computer Networks By Peter L Dordal
5. Fiction Programming the Raspberry Pi- Getting Started with Python - Simon Monk
6. Andrew S. Tanenbaum, “Computer Networks”, Fourth Edition, Prentice Hall PTR, 2002.
7. Designing the Internet of Things (Paperback)by Adrian McEwen,HakimCassimally
8. Stan Openshaw and Ian Turton, “High-Performance Computing and the Art of Parallel Programming”, O’Rielly Press, 2000.

18CN627 BIG DATA FRAMEWORK FOR DATASCIENCE 2-0-1-3

New generation Big data using Functional Programming in Scala: Basic Syntax- type inference and static types- function types and value types, closures. Immutability and immutable types-generic type Parameters-Recursive arbitrary collections-cons list- Iterative arbitrary collections-Arrays-Tail recursion- factorial example-functional abstractions with examples-square root, fixed point, sequence summations. Higher order functions- MapReduce Template-Pattern Matching syntax. Similar higher order (Cons) List operations on arbitrary Collections-filter, fold, partition, span. Basic entity classes and object in Scala. Apache Spark: - Resilient Distributed Data Sets- Creating RDDs, Lineage and Fault tolerance, DAGs, Immutability, task division and partitions, transformations and actions, lazy evolutions and optimization - Formatting and housing data from spark RDDs- Distributed File systemsHDFS and Tachyon-Persistance. Setting up a standalone Spark cluster-: spark-shell, basic API, ModulesCore-Key/Value pairs and other RDD features, MLlib-examples for bi-class SVM and logistic regression, Streaming and stream context, GraphX- streaming work count and page rank example. Data Frames and Datasets. Creating data frames from RDDs. Using Spark SQL to query data frames. NoSQL aggregate data bases. Graph data bases and querying them. Some analytics case studies: - Server Log data, Wikipedia dump text, Financial data, image data (using Cifar and Mnist), Matrix/ Vector multiplication and factorization using MapReduce.

TEXT BOOKS/REFERENCES:

1. Learning Spark: Lightning-Fast Big Data Analysis 1st Edition by Holden Karau , Andy Konwinski, Patrick Wendell, MateiZaharia
2. Programming in Scala: A Comprehensive Step-by-Step Guide Third Edition by Martin Odersky, Lex Spoon, Bill Venners.

3. High Performance Spark: Best Practices for Scaling and Optimizing Apache Spark 1st Edition, by Holden Karau, Rachel Warren

4. Scala for the Impatient 2nd Edition, by Cay S. Horstmann

5. Spark: The Definitive Guide: Big Data Processing Made Simple 1st Edition, Kindle Edition by Bill Chambers, MateiZaharia

18RM600 RESEARCH METHODOLOGY 2-0-0-2

Unit I:
Meaning of Research, Types of Research, Research Process, Problem definition, Objectives of Research, Research Questions, Research design, Approaches to Research, Quantitative vs. Qualitative Approach, Understanding Theory, Building and Validating Theoretical Models, Exploratory vs. Confirmatory Research, Experimental vs Theoretical Research, Importance of reasoning in research.

Unit II:
Problem Formulation, Understanding Modeling & Simulation, Conducting Literature Review, Referencing, Information Sources, Information Retrieval, Role of libraries in Information Retrieval, Tools for identifying literatures, Indexing and abstracting services, Citation indexes

Unit III:
Experimental Research: Cause effect relationship, Development of Hypothesis, Measurement Systems Analysis, Error Propagation, Validity of experiments, Statistical Design of Experiments, Field Experiments, Data/Variable Types & Classification, Data collection, Numerical and Graphical Data Analysis: Sampling, Observation, Surveys, Inferential Statistics, and Interpretation of Results

Unit IV:
Preparation of Dissertation and Research Papers, Tables and illustrations, Guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript. References, Citation and listing system of documents

Unit V:
Intellectual property rights (IPR) - patents-copyrights-Trademarks-Industrial design geographical indication. Ethics of Research- Scientific Misconduct- Forms of Scientific Misconduct. Plagiarism, Unscientific practices in thesis work, Ethics in science

TEXT BOOKS/ REFERENCES:

1. Bordens, K. S. and Abbott, B. B., “Research Design and Methods – A Process Approach”, 8th Edition, McGraw-Hill, 2011
2. C. R. Kothari, “Research Methodology – Methods and Techniques”, 2nd Edition, New Age International Publishers
3. Davis, M., Davis K., and Dunagan M., “Scientific Papers and Presentations”, 3rd Edition,

Elsevier Inc.
4. Michael P. Marder,“ Research Methods for Science”, Cambridge University Press, 2011
5. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”. Aspen Law & Business; 6 edition July 2012

ELECTIVES

18RW701 GUIDANCE, NAVIGATION AND CONTROL: THEORY AND APPLICATIONS 3-0-0-3

Origin of sensor errors, how they propagate and are modeled and simulated – Probability, random processes, estimation theory and the Kalman Filter – The kinematics, dynamics and control of 6-DoF motion – Principles of Geodesy and the WGS-84 datum – Earth-based navigation by celestial, inertial and radio systems – IMU sensors: Gyroscope and accelerometer principles – Error sources – UAS and missile guidance

TEXT BOOKS/REFERENCES:

1. Etkin B, "*Dynamics of Atmospheric Flight*", Dover, 2005
2. Groves P, "*Principles of GNSS, Inertial, and Integrated Navigation Systems*", Artech House, 2008
3. Titterton D andWeston J, "*Strapdown Inertial Navigation Technology*", IET, 2004

18RW702 GEOGRAPHICAL INFORMATION SYSTEMS: PRINCIPLES AND APPLICATIONS 2-0-1-3

Remote sensing Data Types-digital analogue-drainage pattern-erosionland depositional land forms-floodplain mapping-coastal land forms-glacial land forms.Hazards-earthquake and volcanoes – landslide -forest fire –oil spill. Land use /Land cover: concepts-classification:- Landusemapping-land evaluation.Agriculture:cropassessment,disease detection, forestry:types – species identification and diseases detection.Soils:Soil mapping-Soil moisture- soil erosion – reservoir station-soil salinity-soil conservation.Water resources- water quality monitoring and mapping-water pollution,identification ground water potential and recharge areas-integrated watershed development. GIS application- Fundamentals of GIS-layers and themes-modelingweighing-specific applications-infrastructure. Application to agriculture-water management – database creation- networking of data, Map scaling.Application of GIS in environment-damage assessment- Coastal and marine applications.ESA, ISRO, and NASARS: mapping, navigation, and current and future missions for earth, solar system planets and satellites. Shuttle Radar Topography Mission, Uninhabited Aerial Vehicle, Industry Standard Software in GIS/RS: Arc GIS, ERDAS, ILWIS, QGIS, ENVI. Digital Science and art of designing and producing maps – basic principles of digital map design and production – Established cartographic design principles – scale and projection, symbolization and classification techniques – use of tones and colors, and techniques for portraying surfaces - Cartographic functionalities for Map Design - Open Source GIS – Import and Export of spatial data – Practical Applications

TEXT BOOKS/REFERENCES:

1. Lilles and Keifer, Remote Sensing and Image Interpretation, John Wiley and Sons, New York, 2004.
2. George Joseph , Fundamentals of Remote Sensing, Universities Press(India)Ltd, Hyderabad, 2003.
3. Deren Li, Jie Shan and Jianya Gong, Geospatial Technology for Earth Observation, Springer, 2009.
4. Scott Gleason and DemozGebre-Egiabher, GNSS Applications and Methods, Artech House Publishers, 2009.

18RW703 FUNDAMENTALS OF SYNTHETIC APERTURE RADAR SIGNAL PROCESSING 3-0-0-3

Foundations – Common synthetic aperture imaging algorithms: Doppler beam sharpening, range, Doppler, range migration, and polar format – Emerging SAR techniques: back-projection – Interferometric SAR for 3D mapping and change detection – SAR image exploitation and parameter retrieval – Understand fundamental SAR system characteristics of resolution, coverage, and image quality and their determinants – Explore the similarities and differences of major 2D and 3D imaging modes – Learn the advantages and limitations of many common SAR image formation algorithms – Interpret SAR imagery – Size SAR signal processors and data links – Master motion compensation and auto-focus algorithms – Integrate SAR and GMTI modes – Generate 2D and 3D target signatures using turntable ISAR ranges – Avoid common SAR misconceptions – Recognize how SAR concepts and basic calculations are applied to a variety of systems.

TEXT BOOKS/REFERENCES:

1. Cloude SR, "*Polarisation: applications in remote sensing*", Oxford University Press, 2009
2. Curlander JC, Mcdonough RN, "*Synthetic aperture radar: systems and signal processing*", Wiley, 1991
3. Franceschetti G, Lanari R, "*Synthetic aperture radar processing*", CRC Press, 1999

18RW704 SPACE-TIME ADAPTIVE PROCESSING: APPLICATION TO RADAR 2-0-1-3

Fundamental considerations and digital signal processing review – Temporal and spatial beamforming algorithms – Space-time adaptive processing fundamentals – STAP algorithms/architectures: design and implementation – Practical concerns affecting real-world STAP implementation and performance: computer laboratory and numerical exercises – Evaluate the impact of clutter on radar system detection performance – Identify applications of STAP technology and the corresponding benefits

TEXT BOOKS/REFERENCES:

1. Richard Klemm, "*Principles of Space-time Adaptive Processing*", IET, 2002
2. Guerci JR, "*Space-time Adaptive Processing for Radar*", 2nd Ed., Artech House, 2003
3. Melvin M. Weiner, "*Adaptive Antennas and Receivers*", CRC Press, 2005

18RW705 PRINCIPLES OF SATELLITE NAVIGATION 3-0-0-3

Fundamentals of Satellite Navigation – Reference Coordinate Systems – Ranging Using TOA Measurements – EDM Satellite Orbits – Position Determination Using PRN Codes – GPS System Segments – Signal Characteristics – Navigation Message Format – Signal Acquisition, Tracking, and Data Demodulation – Interference, Multipath, and Scintillation – Differential GPS

TEXT BOOKS/REFERENCES:

1. John WB, "*Engineering Satellite-Based Navigation and Timing: Global Navigation Satellite Systems, Signals, and Receivers*", John Wiley & Sons, 2015
2. Bob Williams, "*Intelligent Transport Systems Standards"*, Artech House, 2008
3. Pat Norris, "*Watching Earth from Space*", Springer Science & Business Media, 2010
4. XuGuochang, "*GPS: Theory, Algorithms and Applications*", Springer Science & Business Media, 2007

18RW706 SATELLITE REMOTE SENSING ASTRODYNAMICS 3-0-0-3

Orbital mechanics – Orbital elements – Ground trace – Remote sensing satellite (RSS) classification based on orbits and purpose – Two-line element (TLE) – Sun-synchronous orbit (SSO) – Orbital perturbations – Multi-SSO – Space environment – Atmospheric density models – Attitude determination and control system (ADCS) – ADCS sensors – Reference frames – Ephemeris – Orbital lifetime and decay – Ballistic coefficients – RSS classifications based on mission requirements – Performance parameters – Navigation and tracking – Beta angle – GPS & Autonomous navigation/control – Communications – Link equation – Hardware – Central processing – RSS structural design – RSS constellations – Mission simulations software – Orbital parameter estimation using cloud computing

TEXT BOOKS/ REFERENCES:

1. David A. Vallado, "*Fundamentals of Astrodynamics and Applications,*" Third Edition, Microcosm Press Inc., 2007.
2. Rainer Sandau, Hans-Peter Roeser, Arnoldo Valenzuela (Ed.), "*Small Satellite Missions for Earth Observation: New Developments and Trends,*" First Edition, Springer, 2010
3. Frank M. Flechtner, MioaraMandea, Thomas Gruber, Markus Rothacher, Jens Wickert, Andreas Günter, TiloSchöne (Ed.), "*System Earth via Geodetic-Geophysical Space Techniques (Advanced Technologies in Earth Sciences),*" First Edition, Springer, 2010
4. Herbert J. Kramer, "*Observation of the Earth and Its Environment: Survey of Missions and Sensors,*" Second Edition, Springer-Verlag, 1994

18RW707 HYPERSPECTRAL IMAGING SYSTEMS 2-0-1-3

Introduction to hyperspectral imaging – Visualization of hyperspectral images – Challenges of hyperspectral data processing – Band detection – Band selection – Band Denoising: Least Square, Total Variation, Legendre-Fenchel Transformation Sparse Filter– Classification Techniques for hyperspectral data analysis: Support Vector Machines - Recursive Least Squares - Sparsity based classification algorithms - Alternating Direction Method of Multipliers (ADMM) – Algorithm demonstrations and practice , Vectorized Convolutional Neural Networks

TEXT BOOKS/REFERENCES:

1. Bioucas-Dias, Jos M., Antonio Plaza, Gustavo Camps-Valls, Paul Sche- unders, NASSER M. Nasrabadi, and Jocelyn Chanussot. Hyperspectral remote sensing data analysis and future challenges. IEEE Geoscience and Remote Sensing Magazine,1(2), 6-36, 2013.
2. Qiangqiang Yuan, Liangpei Zhang and HuanfengShen. Hyperspectral image denoising employing a spectral-spatial adaptive total variation model. Geoscience and Remote Sensing, IEEE Transactions on 50, no. 10 : 3660-3677, 2012
3. AnkurHanda, Richard A. Newcombe, AdrienAngeli and Andrew J. Davison. Applications of Legendre-Fenchel transformation to computer vision problems. Department of Computing at Imperial College London, DTR11-7 45, 2011
4. Yi Chen, Nasser M. Nasrabadi and Trac D. Tran. Hyperspectral image classification using dictionary-based sparse representation. Geoscience and Remote Sensing, IEEE Transactions on Vol. 49, no. 10, pp. 39733985, 2011.
5. Jos M. Bioucas-Dias, and Mrio AT Figueiredo. Alternating direction algorithms for constrained sparse regression: Application to hyperspectralunmixing. In Hyperspectral Image and Signal Processing: Evolution in Remote Sensing (WHISPERS), 2010 2nd Workshop on, pp. 1-4. IEEE, 2010.
6. Camps-Valls, Gustavo, and Lorenzo Bruzzone. Kernel-based methods for hyperspectral image classification. IEEE Journal on Selected Topics in Applied Earth Observations and Remote Sensing.,43(6), 1351-1362, 2005.

18RW708 PRACTICAL GIS 0-0-3-3

Introduction to GIS for Earth Observation - Land Applications - Ocean Atmosphere and Crysphere Applications - Environment and Security - Synergy with Other Space Technology - Advanced Technology for Earth Observation - GIS data models - Tabular analysis - Point analysis - Line analysis - Network analysis - Dynamic segmentation - Polygon analysis - Grid analysis - Image analysis - Modeling - Geocoding Basics- Thematic Information from Space- Height Information from Space

TEXT BOOKS/REFERENCES:

1. David L Verbyla, "*Pracital GIS Analysis*," Taylor and Francis, 2002
2. Neteler Markus, Mitasova Helena, "*Open Source GIS*," Springer, 2008
3. Linder Wilfried, "*Digital Photogrammetry*," Springer, 2009
4. Williams Jonathan, "*GIS Processing of Geocoded Satellite Data*," Springer, 2001

18RW709 VEHICULAR COMMUNICATION, NAVIGATION AND CONTROL 2-0-1-3

Need of vehicular communication - Safety - Classification of safety applications - Bidirectional transmission schemes - Non-autonomous systems - Autonomous systems, ad-hoc services,

bidirectional communication, position based communication, multi-hop position based communication, information in the vehicular network, routing

TEXT BOOKS/REFERENCES:

1. RaduPoescu-Zeletin, IljaRadusch, Mihai Adrian Rigani, "*Vehicular 2-X Communication*," Springer, 2010
2. Xiang W., "*Wireless Access in Vehicular Environments Technology*", Springer, 2015
3. Luan T.-H., Shen X. (Sherman), and Bai F., "*Enabling Content Distribution in Vehicular Ad Hoc Networks*", Springer, 2014

18RW710 MICROWAVE REMOTE SENSING 3-0-0-3

Overview of microwave systems, physical fundamentals, polarimetry, microwaves in the real world, detecting microwaves, atmospheric sounding, passive imaging, active microwaves, imaging radar, interferometry,

TEXT BOOKS/REFERENCES:

1. Iian H Woodhouse, " Introduction to Microwave Remote Sensing", CRC Press, 2005
2. J A Richards, "*Remote Sensing with Imaging Radar*," Springer, 2009
3. Sharkov Eugene A, "*Passive Microwave Remote Sensing of the Earth*," Springer, 2003
4. Jin, Ya-Qiu, "*Theory and Approach of Information Retrievals from Electromagnetic Scattering and Remote Sensing*," Springer, 2006
5. Kozlov, A.I., Ligthart, L.P., Logvin, A.I., "*Mathematical and Physical Modelling of Microwave Scattering and Polarimetric Remote Sensing*," Springer, 2002

18RW711 LIDAR 3-0-0-3

Introduction to LIDAR - Polarization in LIDAR - LIDAR and multiple scattering - LIDAR and atmospheric aerosol particles - High spectral resolution LIDAR - Visibility and cloud LIDAR - Different absorption LIDAR - Raman LIDAR - Temperature measurements with LIDAR - Resonance Scattering LIDAR - Doppler Wind LIDAR - Airborne and Spaceborne LIDAR

TEXT BOOKS/REFERENCES:

1. Claus Weitkamp, "*LIDAR-Range resolved, optical remote sensing of the atmosphere*", Springer, 2005

2. Ansmann A, Neuber R, Rairoux P, Wandinger U, "*Advances in Atmospheric Remote Sensing with Lidar*," Springer, 1997

3. Zuev V E, Naats I E, "Inverse Problems of Lidar Sensing of the Atmosphere," Springer, 1983

18RW712 GRAVITATIONAL WAVE REMOTE SENSING 3-0-0-3

Sources of gravitational waves - Sources of Gravitational Radiation - The Rate of Gravitational Collapse in the Milky Way - Gravitational Radiation from Rotating Stellar Core Collapse - Remarks on SN 1987a - Coalescing Binaries to Post-Newtonian Order - Principles of Signal Processing - A Review of the Statistical Theory of Signal Detection - Radio Pulsar Search Techniques - Sample Covariance Techniques in the Detection of Gravitational Waves - Gravitational wave detectors - Resonant-bar detectors - Gravity wave dewars - Detection of continuous wave - Data analysis and algorithms for gravitational wave antennas - Fabry-Perot cavity gravity-wave detectors - Gravitational wave detection at low and very low frequencies - Spacecraft Gravitational Wave Experiments - Gravitational Antenna Bandwidths and Cross Sections - Comparison of Bars and Interferometers: Detection of Transient Gravitational Radiation - Broadband Search Techniques for Periodic Sources of Gravitational Radiation

TEXTBOOKS/REFERENCES:

1. David G Blair,"*The Detection of Gravitational Waves*" Cambridge University Press, 1991
2. Bassan Massimo, "*Advanced Interferometers and the Search for Gravitational Waves*," Springer, 2014
3. Schutz B F, "*Gravitational Wave Data Analysis*," Springer, 1989

18RW713 ACOUSTIC REMOTE SENSING 3-0-0-3

Acoustic remote sensing - Instrumentation.- Physical Grounds for Acoustic Remote Sensing of the Atmospheric Boundary Layer; Technological Development of Atmospheric Echosounders - Atmosphere near the ground - Sound in atmosphere - Scattering - Sound transmission and reception - SODAR - Calibration - SODAR signal analysis - Detecting signals in noise - Turbulent intensities - Enhancement of signals - Measurement errors - Acoustic Propagational Characteristics and Tomography Studies - Spreading and subduction - Abyssal basins and the polar seas - Continental margins - Shallow-water environments - Man-made structures - Anomalies and artifacts - Computer-assisted interpretation

TEXTBOOKS/REFERENCES:

1. Stuart Bradley, " Atmosphere acoustic remote sensing", CRC press, 2008
2. Caiti A, Chapman N R, Hermand J-P, Jesus S M, "*Acoustic Sensing Techniques for the Shallow Water Environment*," Springer, 2006
3. SingalSagar Pal, "*Acoustic Remote Sensing Applications*," Springer, 1997
4. Blondel Philippe, "*The Handbook of Sidescan Sonar*," Springer, 2009

18RW714 REMOTE SENSING USING MAGNETIC-FIELDS 3-0-0-3

IMS Satellites - The Los Alamos Synchonous Orbit Data Set - Satellite Instrumentation and Data - Space Environment Monitoring by Low-Altitude Operational Satellites - Atmosphere Explorer and the IMS - Magsat Data Availability - Ground Based Observations - Magnetometer Networks - Midlatitude Magnetometer Chains During the IMS - The Stare System and Some of Its Applications - Worldwide Incoherent Scatter Radar Measurements - ISEE-Magnetoapuse Observations

TEXT BOOKS/REFERENCES:

1. Russell C T, Southwood D J, "*The IMS Source Book: Guide to the International Magnetospheric Study Data Analysis*," Wiley, 2003
2. Reid AB *et al*., "*GEOPHYSICS: Magnetic interpretation in three dimensions using Euler deconvolution*," Society of Exploration Geophysicists, 1990
3. Richard J Blakely and Robert W Simpson, "Approximating edges of source bodies from magnetic or gravity anomalies," Society of Exploration Geophysicists, 1986

18RW715 RF ANTENNA SYSTEMS 3-0-0-3

Analysis techniques for designing reflector antennas - measurement technique - techniques for designing beam-waveguide systems - Deep-space station - Reflex-dichroic feed systems - L-band distortion compensation - Multi-frequency operation - Antenna research system task - Computational Electrodynamics - FDTD - FEM - MoM - Mobile Communication Systems - Simulation - Transfer Function - Electromagnetic Bandgap Material - Gain Enhancement for Terahertz Planar - Spectrum Scarcity - Terahertz Communication Systems - Terahertz Planar Antenna - Terahertz Wireless Communication

TEXT BOOKS/REFERENCES:

1. William A Imbriale, "*Large Scale Antennas of Deep Space Networks*", Wiley, 2003
2. Arik D Brown, "*Electronically Scanned Arrays MATLAB® Modeling and Simulation*," CRC Press, 2012
3. ChandranSathish, "*Adaptive Antenna Arrays*," Springer, 2004
4. Gustrau Frank, Manteuffel Dirk, "*EM Modeling of Antennas and RF Components for Wireless Communication Systems*," Springer, 2006
5. JhaKumudRanjan, Singh Ghanshyam, "*Terahertz Planar Antennas for Next Generation Communication*," Springer, 2014

18RW716 GEOSPATIAL INTELLIGENCE 3-0-0-3

Geographic intelligence (GEOINT) - Categories of GEOINT - Multilevel GEOINT - GEOINT cycle - Core areas of intelligence planning process - Support planning, operations, communication and information systems, security - Semantic referencing of geosensor data and volunteered geographic information - Spatial cyberinfrastructure: building new pathways for geospatial semantics on existing infrastructures - Location-based access control using semanticweb technologies - Topographic mapping data semantics through data conversion and enhancement

TEXT BOOKS/REFERENCES:

1. Committee and Staff of the NRC, "*Future US Worksforce for Geospatial Intelligence*", The National Academic Press, 2013
2. Ashish Naveen, ShethAmit P, "*Geospatial Semantics and the Semantic Web*," Springer, 2011
3. LakshmananValliappa, "*Automating the Analysis of Spatial Grids*," Springer, 2012

18RW717 GEOANALYTICS 3-0-0-3

Introduction to geo spatial analysis - Data collection, processing and applications for geospatial analysis - Fuzzy set theory in geospatial analysis - Thematic cartography and geovisualization - Spatial prominence and spatial weights matrix in geospatial analysis - Geographically weighted regression in geospatial analysis - Statistical and Graphical Foundation - Multi-layer perception neural networks in geospatial analysis - GIS network model in geospatial analysis

TEXT BOOKS/REFERENCES:

1. Yuji Murayama, "*Progress in Geospatial Analysis*,"Springer,2012
2. Terry A Slocum, Robert B McMaster, Fritz C Kessler, and Hugh H Howard., "*Thematic Cartography and Geovisualization*,"Pearson Education, Inc., 2008
3. Natalia Andrienko and Gennady Andrienko, "*Exploratory Analysis of Spatial and Temporal Data*," Springer-Verlag, 2005
4. Gennady Andrienko, Natalia Andrienko, Peter Bak, Daniel Keim, and Stefan Wrobel, "*Visual Analytics of Movement*," Springer, 2013

18RW718 DEEP SPACE REMOTE SENSING 3-0-0-3

Electromagnetics - Radio spectrum management - Deep Space Radio sources - Characteristics of deep-space radio waves (the radio sky), and changes during propagation from source of origin - Contemporary and futuristic radio telescope systems: Design, ICT infrastructure - Data acquisition schemes - Data formats & archiving schemes - Radio imaging - Reduction and analysis algorithms - Software development: parameterization, calibrating, data processing & software engineering issues - Delay-Doppler image of the solar system; Multidimensional Imaging Radar Data Visualization

TEXT BOOKS/REFERENCES:

1. Thomas L. Wilson, Kristen Rohlfs and Susanne Hüttemeister , "*Tools of Radio Astronomy*", Springer, 2009
2. L.E. Kopilovich and L.G. Sodin, "*Multielement System Design in Astronomy and Radio Science* ", Springer, 2001
3. John D Kraus, "*Radio Astronomy*", Tata McGraw-Hill Inc., 1996
4. A Richard Thompson, James M Moran, and George W Swenson Jr, "*Interferometry and Synthesis in Radio Astronomy*", Wiley, 2001
5. Gerrit L. Verschuur, "*Galactic and Extragalactic Radio Astronomy"*, Springer-Verlag, 1991

18RW719 GEOSPATIAL TECHNOLOGIES FOR URBAN PLANNING 3-0-0-3

Urban Planning: Challenges and Opportunities in Present Context, Remote Sensing Overview and Earth Observation Data for Urban Planning, GIS Concepts and Spatial Database for Urban Planning ,Geospatial Data and Services on BhuvanGeoportal ,Open Source Tools and Datasets for Urban Planning , Urban/ Regional Features Extraction Using Remote Sensing Data GPS Concepts, Mobile Mapping and Application in Urban Utility Mapping , Crowd sourcing and Mobile Apps for Citizen-centric services ,National Urban Information System (NUIS) and Bhuvan-NUIS BDB, Base Maps and Cadastral Mapping Urban Land use/ Land cover Classification , Urban Sprawl and Urban Growth Modeling , Urban Green Spaces, Land Surface Temperature Studies in Urban Areas , Urban Seismic Risk Assessment ,3D City Modeling for Urban Planning , Close Range Photogrammetry for Urban Heritage Studies Smart City and AMRUT: Mission Guidelines, Challenges and Opportunities.

TEXT BOOKS/REFERENCES:

1.JulianaMaantay, John Ziegler, John Pickles, GIS for the Urban Environment, Esri Press 2006.

2 .Allan Brimicombe, GIS Environmental Modeling and Engineering, CRC; 1 edition 2003. CRC Press, 2ndEdition, 2009, ISBN: 978-1439808702

3. Paul Longley, Michael Batty, Spatial Analysis: Modeling in a GIS Environment Wiley, 1997.

4. Michael F. Goodchild, Louis T. Steyaert, Bradley O. Parks, Carol Johnston, David Maidment,Michael Crane, Sandi Glendinning, GIS and Environmental Modeling: Progress and Research Issues (Hardcover) by,Publisher: Wiley; 1 edition, 1996.

5. Roland Fletcher, The Limits of Settlement Growth: A Theoretical Outline (New Studies in Archaeology) (First edition), Cambridge University Press; 2007.

6.SaidEasa, Yupo Chan, “Urban Planning and Development Applications of GIS”, Amer Society of Civil Engineers, 1999, ISBN: 978-0784404614

7. Harvey J. Miller, Shih-Lung Shaw, “Geographic Information Systems for Transportation: Principles and Applications (Spatial Information Systems)”, Oxford University Press, USA (2001) , ISBN: 978-0195123944

18RW720 AERIAL PHOTOGRAPHY AND PHOTOGRAMMETRY 3-0-0-3

Introduction to aerial photography – Basic information and specifications of aerial photographs Planning and execution of photographic flights Aerial cameras – Types and their characteristics Aerial film negative and its processing- completion of photographic task- Introduction – Definition and terms in Photogrammetry Types of aerial photographs Geometry of Aerial Photographs Introduction to digital photogrammetry- Orthophotos and digital orthophotography Making measurements from aerial photographs, Measurement of height from Aerial Photograph Relief displacement of vertical features and its determination Vertical exaggeration and slopes – Factor affecting vertical exaggeration and its determination Elements of photo interpretation , Symbols and colour schemes used in photo interpretation Principles of stereo photogrammetry Model deformation and rectification Simple plotting Instruments – simple and stereo plotters

TEXT BOOKS/REFERENCES:

1) Gupta, R.P.., 1990: Remote Sensing Geology. Springer Verlag.
2) Jensen, J.R. 2000 : Remote Sensing of the Environment: An Earth resource Perspective. Prentice Hall
3) Lillesand, T.M., and Kieffer, R.M., 1987: Remote Sensing and Image Interpretation, John Wiley.
4) Miller, V.C., 1961: Photogeology. McGraw Hill.

18RW721 GEOSPATIAL APPLICATIONS FOR AGRICULTURE AND FORESTRY 3-0-0-3

Spectral properties of crops in optical & TIR region, Microwave backscattering behavior of crop canopy – crops identification and crop inventory - Soil classifications – Soil survey, Types and methods - Soil mapping - watershed management - Forest taxonomy – inventory of forest land – forest types and density mapping - Forest fire mapping & damage assessment - global effects and climatic changes in forestry and agriculture - Case studies.

TEXT BOOKS/REFERENCES:

1. AnjiReddy,M. 2004 : Geoinformatics for environmental management.B.S. Publications
2. Franklin S.E. 2001. Remote Sensing for sustainable forest management. Lewis Publication

3. Gupta, R.P.., 1990: Remote Sensing Geology. Springer Verlag. Jensen,J.R. 2000 : Remote Sensing of the Environment: An Earth resource Perspective.Prentice Hall
4. Lillesand, T.M., and Kieffer, R.M., 1987: Remote Sensing and Image Interpretation, John Wiley.

18RW722 GEOSPATIAL APPLICATIONS FOR OCEANOGRAPHY 3-0-0-3

Costal processes – Oceanic circulation - reflection, diffraction and refraction in Oceans - properties of sea water and parameters – Coastal erosion and protection - sea surface temperature – Use of Microwave Data – Sensors for Ocean Monitoring - Integrated coastal Zone Management – Case Studies

TEXT BOOKS/REFERENCES:

1.Shunlnliang, Advances in land RS: System, modeling invention and applications, 2001.
2. Joe Boris dexon, Soil mineralogy with environmental application, Library of congress catalog, 2004.
3. James B, Introduction of Remote sensing, Third edition Campbell, third edition Guilford Press, 2002.

18RW723 STATISTICAL AND ADAPTIVE SIGNAL PROCESSING 2-0-1-3

Review of random variables, Parameter Estimation Theory, Estimation of signal in presence of white Gaussian Noise, Adaptive Filtering.

TEXT BOOKS/ REFERENCES:

1. M. Hays: Statistical Digital Signal Processing and Modelling, John Willey and Sons, 1996.
2. M.D. Srinath, P.K. Rajasekaran and R. Viswanathan: Statistical Signal Processing with Applications, PHI, 1996.
3. Simon Haykin: Adaptive Filter Theory, Prentice Hall, 1996.
4. D.G. Manolakis, V.K. Ingle and S.M. Kogon: Statistical and Adaptive Signal Processing, McGraw Hill, 2000. 5. S. M. Kay: Modern Spectral Estimation, Prentice Hall, 1987.

18RW724 DIGITAL CONTROL SYSTEM 2-0-1-3

Concept & Representation of Discrete time System, State Space Analysis, Controllability, Observability& Stability tests, Design of discrete time Controllers and observers, State Observers.

TEXT BOOKS/ REFERENCES:

1. B. C. Kuo, Digital Control Systems, Oxford University Press, 2/e, Indian Edition, 2007.
2. K. Ogata, Discrete Time Control Systems, Prentice Hall, 2/e, 1995.
3. M. Gopal, Digital Control and State Variable Methods, Tata Mcgraw Hill, 2/e, 2003.
4. G. F. Franklin, J. D. Powell and M. L. Workman, Digital Control of Dynamic Systems,

5. Addison Wesley, 1998, Pearson Education, Asia, 3/e, 2000. K. J. Astroms and B. Wittenmark, Computer Controlled Systems - Theory and Design, Prentice Hall, 3/e, 1997.

18RW725 DATA COMMUNICATIONS & COMPUTER NETWORKS 2-0-1-3

Introduction, Bandwidth utilization, Connecting LANs, Backbone Networks, and Virtual LANs, Connecting Devices, Network Layer, Transport Layer, Application Layer, WWW and HTTP.

TEXT BOOKS/ REFERENCES:

1. Data Communications and Networking, Fourth Edition by Behrouza A. Forouzan,TMH.
2. Computer Networks,A.S.Tanenbaum,4thedition,Pearson education.

18RW726 HARDWARE SOFTWARE CO-DESIGN 2-0-1-3

Co-design overview, Models and methodologies of system design, Hardware software partitioning and scheduling, Co-simulation, synthesis and verifications, Architecture mapping, HW-SW Interfaces and Reconfigurable computing, System on Chip (SoC) and IP cores, Low-Power Techniques in RT Embedded Systems, On-chip Networking, Sensor Networks, Software for Embedded Systems, Introduction to Xilinx Zynq and Vivado, Dataflow modeling.

TEXT BOOKS/ REFERENCES:

- Hardware/Software Co-Design Principles and Practice by J.Staunstrup and W.Wolf
- A Practical Introduction to Hardware Software Co-design by Patrick Schaumont

18RW727 DSP PROCESSORS AND ARCHITECTURE 2-0-1-3

Introduction to Digital Signal Processing, Computational Accuracy In DSP Implementations, Architectures For Programmable DSP Devices, Execution Control And Pipelining, Programmable Digital Signal Processors, Implementations Of Basic DSP Algorithms, Implementation Of FFT Algorithms, Interfacing Memory and I/O Peripherals to programmable DSP Devices.

TEXT BOOKS/ REFERENCES:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. S. Chand & Co,2002