COLLEGE OF ENGINEERING, PUNE (COEP)

(An Autonomous Institute of Government of Maharashtra.)
SHIVAJI NAGAR, PUNE - 411 005 (MH) INDIA

E & TC Department – Honors Scheme
Honors in Communication
AY 2020-21

Structure

SR.No.	Courses Name	Credits	Offered in semester
1	Machine Learning	3	5th
2	Wireless Sensor Networks	3	6th
3	Advances in Digital Communication	3	7th
4	Software Defined Networks	3	8th

Syllabus

Machine Learning

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks each, End-Sem Exam – 60

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Grasp and develop machine learning algorithms namely linear, logistic and multivariate regression
2. Design and implement machine learning solutions to classification and clustering problems
3. Evaluate and interpret the results of the machine learning algorithms.

Syllabus Contents:

Review of Probability Theory and Linear algebra, Convex Optimization, Introduction to Statistical Decision Theory, Regression: Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component Regression, Logistic Regression, Partial Least Squares Classification: Linear Classification, LDA

Introduction to Perceptron and SVM, Neural Networks: Introduction, Early Models, Perceptron Learning, Back-propagation, Initialization of neural network, Training and Validation, Parameter Estimation

Decision Trees - Stopping Criterion and Pruning, Loss function, Categorical Attributes, Multiway Splits, Missing values, Instability, Regression Trees. Bootstrapping and Cross Validation, Class Evaluation, Measures, ROC curve, MDL, Ensemble methods, Committee Machines and Stacking.

Gradient Boosting, Random Forests, Multi-class Classification, Naïve Bayes, Bayesian Networks, Undirected Graphical Models, HMM, Variable elimination, Belief Propagation, Partitional clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density- Based Clustering, Gaussian Mixture Models, Expectation Maximization, Learning Theory, Re-enforcement Learning

References:

1. Ethem Alpaydin, “Introduction to Machine Learning”, PHI, 2005
2. Bishop Christopher, “Neural Networks for Pattern Recognition”, New York, NY: Oxford University Press, ISBN: 9780198538646
3. Mitchell Tom, “Machine learning”, New York, NY: McGraw-Hill, ISBN:9780070428072

4. Hastie, T. R. Tibshirani, and J. G. Friedman, "The Elements of Statistical Learning: Data Mining, Inference and Prediction", New York, NY: Springer, ISBN:9780387952840
5. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani "Introduction to Statistical Learning", Springer, 2013.

Wireless Sensor Networks

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks each, End-Semester Exam – 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

1. Learn the basic principles, characteristics, operational challenges and design considerations for sensor network.
2. Understand architecture, hardware details, software, operating systems, programming techniques & simulation platforms for wireless sensor network based systems and applications.
3. Analyze radio standards and concepts of wireless communication, routing protocols for different network layers to be used for wireless sensor network.
4. Study wireless sensor network based systems with special features like energy conservation, topology control, location management, database management, security.
5. Design wireless sensor network system for variety of applications as per user requirement.

Syllabus Contents:

Mobile Ad Hoc Networks (MANET): Introduction, Self-organizing behavior, Co-operation), Types of MANETs, Opportunistic Mobile Networks, UAV networks, Wireless Sensor Networks (WSN) Introduction and overview of sensor network architecture and its applications, challenges, design considerations for sensor network, comparison with Ad Hoc Networks. Sensor Network architecture, Sensor network scenarios, types of sources and sinks, single hop verses multi hop communication, multiple sources and sinks, mobility issues, need of Gateway. Sensor network associated hardware, software, OS, programming tools, simulation platform details.
Hardware: Types of Sensors like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT,

Software: Operating Systems(OS) requirements, examples: tinyOS, MANTIS, Contiki, and RetOS.

Programming tools: C, nesC, Simulation platforms: Performance comparison of wireless sensor networks based on platforms like open source (ns-2, ns-3) and commercial (QualNet, Opnet)
Routing Challenges, Design Issues, and Performance requirements related to Wireless Sensor Networks Overview of sensor network protocols: Physical, MAC, Routing, Network layer protocols, node discovery protocols, multi-hop and cluster based protocols.

Radio standards: fundamentals of 802.15.4 standard, Bluetooth, and UWB; Overview of different Localization techniques, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, clustering, time synchronization Data dissemination and processing; differences compared with other database management systems, data storage; query processing. Security, security challenges: possible attacks, countermeasures
Emerging technologies and Specialized features for WSN: Energy preservation and energy efficient networks; fault-tolerance. Open issues for future research and Enabling technologies in WSN.

References:

1. H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons,

India, 2012.
2. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, “Wireless Sensor Networks”, Springer Verlag, 1st Indian reprint, 2010.
3. F. Zhao and L. Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Morgan Kaufmann, 1st Indian reprint, 2013.
4. Yingshu Li, MyT. Thai, Weili Wu, “Wireless sensor Network and Applications”, Springer series on signals and communication technology, 2008.

Advances in Digital Communication

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks each, End-Semester Exam – 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

1. Understand and visualize the different Digital modulation and spread spectrum techniques.
2. Apply different types of coding techniques to design the optimum receiver for different channels.
3. Design and develop the different types of modulation techniques, equalizer to improve the performance under fading channels for various applications.

Syllabus Contents:

Overview of digital communication: principles, base-band and band-pass digital modulation-demodulation schemes.

Coding techniques: Information measures, Coding techniques for discrete and analog sources.Channel capacity, error detection and correction codes - Linear block codes, cyclic convolutional codes.

Communication through band limited linear filter channels: Optimum receiver for channels with ISI and AWGN, Linear equalization, Decision feedback equalization, Iterative equalization and decoding, Adaptive equalization.

Spread Spectrum signals for digital communication: Model of spread spectrum digital communication system, Direct sequence spread spectrum (DSSS), Frequency hopped spread spectrum (FHSS), CDMA, Time hopping Spread Spectrum (THSS), Synchronization of spread spectrum systems.

Digital communication through fading multi-path channels: Characterization of fading multipath channels, The effect of signal characteristics on the choice of a channel model, Frequency nonselective, Slowly fading channel, Diversity techniques for fading multipath channels, Digital signals over a frequency selective, Slowly fading channel.

References:

1. John G. Proakis and Masoud Salehi, “Digital Communications”, Tata McGraw Hill, 5th Edition.
2. Bernard Sklar and Pabitra Kumar Ray, “Digital Communications: Fundamentals and Applications”, Pearson Education Asia, 2nd Edition.
3. John R. Barry, Edward A. Lee and David G. Messerschmitt, “Digital Communication”, Springer 2003, 3rd edition.
4. Andrew J. Viterbi, “CDMA: Principles of Spread Spectrum Communications”, Prentice Hall, USA.

Software Defined Networks

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2 – 20 marks each, End-Semester Exam – 60
Credits-03

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

1. Understand advanced concepts in Programmable Networks.
2. Study Software Defined Networking, an emerging Internet architectural framework.
3. Implement the main concepts, architectures, algorithms, protocols and applications in SDN and NFV

Syllabus Contents:

Introduction to Programmable Networks, History and Evolution of Software Defined Networking (SDN), Fundamental Characteristics of SDN, Separation of Control Plane and Data Plane, Active Networking

Control and Data Plane Separation: Concepts, Advantages and Disadvantages, the basics of Open Flow protocol.

Network Virtualization: Concepts, Applications, Existing Network Virtualization Framework, Mininet A simulation environment for SDN.

Control Plane: Overview, Existing SDN Controllers including Floodlight and Open Daylight projects.

Customization of Control Plane: Switching and Firewall Implementation using SDN Concepts.

Data Plane: Software-based and Hadrware-based; Programmable Network Hardware.

Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs. Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications.

Data Center Networks: Packet, Optical and Wireless Architectures, Network Topologies. Use Cases of SDNs: Data Centers, Internet Exchange Points, Backbone Networks, Home Networks, Traffic Engineering.

References:

1. Thomas D. Nadeau, Ken Gray, “SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies”, O'Reilly Media, August 2013.
2. Paul Goransson, Chuck Black, Timothy Culver. “Software Defined Networks: A Comprehensive Approach”, Morgan Kaufmann Publishers, 2016.
3. Fei Hu, “Network Innovation through OpenFlow and SDN: Principles and Design”, CRC Press, 2014.
4. Vivek Tiwari, “SDN and OpenFlow for Beginners”, Amazon Digital Services, Inc., ASIN: , 2013.
5. Nick Feamster, Jennifer Rexford and Ellen Zegura, “The Road to SDN: An Intellectual History of Programmable Networks” ACM CCR April 2014.
6. Open Networking Foundation (ONF) Documents, https://www.opennetworking.org, 2015.
7. OpenFlow standards, http://www.openflow.org, 2015.

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