SCHEME AND SYLLABUS FOR M.TECH (FULL TIME) DEGREE COURSE

in

COMPUTER SCIENCE AND ENGINEERING

(Specialization: Computer Science)
(2015 Scheme)

under

Faculty of Engineering

of the

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

ALAPPUZHA / PATHANAMTHITTA CLUSTER
(CLUSTER CODE: 03)

SEMESTER 1

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A	03 CS 6141	Theoretical Foundations of Computer Science	4-0-0	40	60	3	4
B	03 CS 6151	Advanced Data Structures and Algorithms	4-0-0	40	60	3	4
C	03 CS 6161	Object Oriented Software Engineering	4-0-0	40	60	3	4
D	03 CS 6171	Computer Security and Applied Cryptography	3-0-0	40	60	3	3
E		Elective 1	3-0-0	40	60	3	3
S	03 RM 6001	Research methodology	1-1-0	100	0	0	2
T	03 CS 6901	Seminar I	0-0-2	100	0	0	2
U	03 CS 6821	Algorithm Design Lab using C/ C++/ JAVA	0-0-2	100	0	0	1
		TOTAL	**19-1-4**	**500**	**300**	**-**	**23**

TOTAL CONTACT HOURS : 24
TOTAL CREDITS : 23

Elective I

03 CS 6181	Grid Computing
03 CS 6191	Digital Image Processing
03 CS 6201	Cyber crime, Legal issues and Ethics

SEMESTER 2

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A	03 CS 6172	Advanced Operating Systems	4-0-0	40	60	3	4
B	03 CS 6182	Modern Computer Networks	3-0-0	40	60	3	3
C	03 CS 6192	Advanced Database Management Systems	3-0-0	40	60	3	3
D		Elective-2	3-0-0	40	60	3	3
E		Elective-3	3-0-0	40	60	3	3
V	03 CS 6902	Mini Project	0-0-4	100	0	0	2
U	03 CS 6822	Operating Systems and Networking Lab	0-0-2	100	0	0	1
		TOTAL	**16-0-6**	**400**	**300**	**-**	**19**

TOTAL CONTACT HOURS : 22
TOTAL CREDITS : 19

Elective II

03 CS 6202	Cloud Computing
03 CS 6212	Advanced Wireless Networks
03 CS 6222	Adhoc and Sensor Networks

Elective III

03 CS 6232	Big Data Processing
03 CS 6242	Data Compression
03 CS 6252	Social Network Analytics

SEMESTER 3

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credits
					Marks	Duration (hours)	
A		Elective IV	3-0-0	40	60	3	3
B		Elective V	3-0-0	40	60	3	3
	03 CS 7903	Seminar II	0-0-2	100	0	0	2
	03 CS 7913	Project Phase I	0-0-8	50	0	0	6
		TOTAL	**6-0-10**	**230**	**120**	**6**	**14**

TOTAL CONTACT HOURS : 16
TOTAL CREDITS : 14

Elective IV

03 CS 7113	Pattern Recognition
03 CS 7123	Computational Linguistics
03 CS 7013	Advanced Data Mining Concepts

Elective V

03 CS 7133	Computational Intelligence
03 CS 7143	Machine Learning
03 CS 7153	Embedded Systems Design

SEMESTER 4

Examination Slot	Course Number	Name	L-T-P	Internal Marks	End Semester Examination		Credit
					Marks	Duration (hours)	
A	03 CS 7914	Project Phase II	0-0-21	70	30	-	12
		TOTAL	**0-0-21**	**70**	**30**	**-**	**12**

TOTAL CONTACT HOURS : 21
TOTAL CREDITS : 12

TOTAL NUMBER OF CREDITS: 68

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6141	**Theoretical Foundations of Computer Science**	4-0-0	4	2015

Course Objectives

- To understand vectors and matrices
- To study mathematical logic
- To study detailed models of computability
- To study graph theory and its applications
- To understand application of probability

Syllabus

Linear Algebra: Vector spaces, Orthogonality, Eigen-value analysis, Vector and matrix norms, Multi variable analysis, Vector and matrix calculus, Unconstrained and constrained optimization problem solving methods. Computability: Turing Machines, Recursive and Recursively Enumerable languages, Decidability, Resource bounded computation. Preliminary ideas of factoring and primality testing – GCD and its complexity – review of finite fields and cyclic groups. Modular Arithmetic - Congruences– The field Z/pZ – Euler's Theorem and Fermat's Little theorem – Euler's ϕ function – Chinese Remainder Theorem. Basic definitions of Graphs, connectivity of a graph, cut points, cycles – Hamiltonian graphs – sub graphs -spanning sub graphs - isomorphic graphs - matrix representation of graphs, Bipartite graphs, Tree, different characterization of trees - Algorithms on graphs – BFS, DFS , Dijkstra's algorithm for shortest path, Floyd's algorithm for all pairs of shortest paths, Kruskal's and Prim's algorithm for minimum spanning tree ,Coloring and planarity. Probability theory-Mathematical Expectations, Random variable and discrete distribution, Binomial distribution, Poisson Distribution, Normal distribution, Mean and variance. Random Variables and Stochastic Processes: Random variables, Functions of random variables, Sequences of random variables, Stochastic processes, Markov chains, Markov processes and queuing theory.

Expected Outcome

- Conceptual understanding of the above topics and ability to apply them in practical situations.

References

1. Discrete Mathematical Structures for Computer Science (1st Ed): Bernard Kolman, Robert Busby, PHI (1984).
2. Linear Algebra and Probability for Computer Science Applications (1st Ed): Ernest Davis, CRC Press (2012).
3. Graph Theory and Its Applications (2nd Ed): Jonathan L. Gross and Jay Yellen, CRC (2005)
4. Schaum's Outline of Probability, Random Variables, and Random Processes (2nd Ed) : Hwei Hsu, McGraw-Hill (2010).
5. Probability and Statistical Inference 7/e, Robert V Hogg, Elliot A. Tanis, Meda J. M. Rao PHI.
6. An Introduction to theory of numbers, Niven, Zuckerman and Montgomery, (Wiley 2006).
7. Elementary Number Theory, Jones and Jones (Springer, 1998).

03 CS 6141- COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Linear Algebra: Vector spaces, Orthogonality, Eigen-value analysis, Vector and matrix norms, Multivariable analysis, Vector and matrix calculus, Unconstrained and constrained optimization problem solving methods. Computability: Turing Machines, Recursive and Recursively Enumerable languages, Decidability, Resource bounded computation.	12	25
FIRST INTERNAL EXAM			
II	Preliminary ideas of factoring and primality testing – GCD and its complexity – review of finite fields and cyclic groups. Modular Arithmetic - Congruences– The field Z/pZ – Euler's Theorem and Fermat's Little theorem – Euler's ϕ function – Chinese Remainder Theorem.	12	25
III	Basic definitions of Graphs, connectivity of a graph, cut points, cycles – Hamiltonian graphs – sub graphs -spanning sub graphs - isomorphic graphs - matrix representation of graphs, Bipartite graphs, Tree, different characterization of trees - Algorithms on graphs – BFS, DFS, Dijkstra's algorithm for shortest path, Floyd's algorithm for all pairs of shortest paths, Kruskal's and Prim's algorithm for minimum spanning tree , Coloring and planarity	16	25
SECOND INTERNAL EXAM			
IV	Probability theory-Mathematical Expectations, Random variable and discrete distribution, Binomial distribution , Poisson Distribution, Normal distribution, Mean and variance. Random Variables and Stochastic Processes: Random variables, Functions of random variables, Sequences of random variables, Stochastic processes, Markov chains, Markov processes and queuing theory.	16	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6151	**Advanced Data Structures and Algorithms**	4-0-0	4	2015

Course objectives

- To know problem solving techniques
- To understand techniques for the design and analysis of efficient algorithms
- To be able to design algorithms for new problems with volume of data

Syllabus

Algorithms -Fundamental Data Structures-Asymptotic Notations and Basic Efficiency classes-Probability-Random Variables and Expectations, Moments and Deviations, distributions, conditional probability, Bayes Theorem- Tail Bounds, Chernoff Bound .Advanced structures for Priority Queues - Single Ended Priority Queues- Leftist Trees, Binomial Heaps, Fibonacci Heaps, Pairing Heaps, and Double Ended Priority Queues - Symmetric Min-Max Heaps, Interval Heaps. Maximum Flow - Flow Networks, Maximum bipartite matching. Problem Solving Techniques-Brute force, divide and conquer, decrease and conquer, transform and conquer, dynamic programming- greedy technique, approximations algorithms- Randomized algorithms, Birthday Paradox, Quick sort, bucket sort, mini-cut, median finding- Random graphs, Ramsey number, Hamiltonian cycles. Algorithms in evolving data streams- Sampling, sketching, data stream models, read-write streams, stream-sort, and map-reduce -Large Graph and Social Networks, Parallel Clustering algorithm for large Data sets with Applications.

Expected Outcome

Upon successful completion of this course, the student will:

- have deep conceptual understanding of advanced data structures and their applications
- know the theory behind various classes of algorithms.
- be able to design, prove the correctness and analyze new algorithms.

References

1. Introduction to Algorithms (3rd Ed): Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, MIT Press (2009).
2. Algorithm Design: Jon Kleinberg and Eva Tardos, AW (2005).
3. Anany V. Levitin. Introduction to the Design & Analysis of Algorithms (2nd Ed): A W (2006).
4. Randomized Algorithms: Rajeev Motwani and Prabhakar Raghavan, Cambridge University Press; Reprint edition (2010).
5. Data Streams: Algorithms and Applications: S. Muthukrishnan, Now Publishers (2005).
6. Data Streams: Models and Algorithms: Charu C. Aggarwal, Springer (2006).
7. Introduction to evolutionary computing: Agoston E. Eiben, J.E. Smith, Springer (2010).
8. Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, Fundamentals of Data Structures in C, Second Edition, University Press, 2008, 2007.

03 CS 6151- COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Algorithms - Problem Solving and Important problem types-Fundamental Data Structures-Asymptotic Notations and Basic Efficiency classes-Analysis of Recursive and Non-Recursive Algorithms-Probability-Random Variables and Expectations, Moments and Deviations, distributions, conditional probability, Bayes Theorem- Tail Bounds, Chernoff Bound .	14	25
FIRST INTERNAL EXAM			
II	Advanced structures for Priority Queues - Single Ended Priority Queues-Leftist Trees, Binomial Heaps, Fibonacci Heaps, Pairing Heaps, and Double Ended Priority Queues - Symmetric Min-Max Heaps, Interval Heaps. Maximum Flow- Flow Networks, Ford-Fulkerson method, Edmonds-Karp algorithm, Maximum bipartite matching	14	25
III	Problem Solving Techniques- Brute force, divide and conquer, decrease and conquer, transform and conquer, dynamic programming- Rod cutting-top down and bottom up approach, Matrix Chain Multiplication, Longest Common Subsequence problem , greedy technique, approximations algorithms-probabilistic analysis , Randomized algorithms, Birthday Paradox, Quick sort, bucket sort, mini-cut, median finding- Random graphs, Ramsey number, Hamiltonian cycles.	16	25
SECOND INTERNAL EXAM			
IV	Algorithms in evolving data streams- Sampling, sketching, data stream models, read-write streams, stream-sort, and map-reduce -Large Graph and Social Networks, Parallel Clustering algorithm for large Data sets with Applications.	12	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6161	**Object Oriented Software Engineering**	4-0-0	4	2015

Course objectives

- To study the basic concepts of project organization and communication.
- To study the definition of system from user's point of view and determine the functionally user's need and usable way of delivering it.
- To provide the necessary methods for analysis and system design.
- To study object design and specify precisely the interface of classes using constraint language and to map the detailed object design model to source code.
- To provide the necessary methods for testing the software

Syllabus

Basic Concepts; Project Organization; Communication - Synchronous, Asynchronous; Life Cycle Model - Sequential, Iterative, Entity centered Model; Project Estimation - COCOMO, COCOMO – II, Agile Process. Requirement Elicitation - Concepts, Activities, Managing; Analysis - Concept, Activities; Design - Concepts, Activities. Object Design Specifying Interfaces – Interfaces Specification Concepts, Interface Specification Activities. Mapping Concepts; Testing – Concepts, Activities – Component Inspection, Usability Testing, Unit Testing, Integration Testing, System Testing, Configuration Management Concepts. UML Diagrams – Use Case, Class, Interaction, State Chart, Activity Diagrams. Case Study – Problem Statements & UML Diagrams of Library Management, ATM Management, and Railway Ticket Reservation Systems.

Expected Outcome

Upon successful completion of this course, students will be able to:

- Apply software development as an engineering discipline.
- Design software.
- To do testing.
- To create a reliable software.

References

1. Bernd Bruegge, Alan H Dutoit, "Object Oriented Software Engineering" Second Edition, Pearson Education, 2004.
2. Stephen Schach, "Applying UML and Patterns", Third Edition, Pearson Education, 2005.

03 CS 6161 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Basic Concepts; Project Organization; Communication - Synchronous, Asynchronous; Life Cycle Model - Sequential, Iterative, Entity centered Model; Project Estimation - COCOMO, COCOMO – II, Agile Process.	14	25
FIRST INTERNAL EXAM			
II	Requirement Elicitation - Concepts, Activities, Managing; Analysis - Concept, Activities; Design - Concepts, Activities. Object Design Specifying Interfaces – Interfaces Specification Concepts, Interface Specification Activities.	12	25
III	Mapping Concepts; Testing – Concepts, Activities – Component Inspection, Usability Testing, Unit Testing, Integration Testing, System Testing, Configuration Management Concepts.	14	25
SECOND INTERNAL EXAM			
IV	UML Diagrams – Use Case, Class, Interaction, State Chart, Activity Diagrams. Case Study – Problem Statements & UML Diagrams of Library Management, ATM Management, and Railway Ticket Reservation Systems.	14	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6171	**Computer Security and Applied Cryptography**	3-0-0	3	2015

Course objectives

- To implement and analyze cryptographic algorithms
- To understand modern cryptographic techniques
- To understand the security techniques

Syllabus

Cryptographic techniques-, Feistel Ciphers- Transposition techniques-Steganography-Symmetric Key cryptography-DES, IDEA, AES, RCS, Blowfish. Asymmetric key cryptography-RSA algorithm, Key Management, Diffie-Hellman key exchange- Message Authentication and Hash functions- MD5 , SHA,RIPEMD- Digital signatures-X.509 authentication service-Kerberos v4 – configuration-Kerberos v5 - Email security- PGP, PEM, S/MIME, Network security – IPSec, Web security – SSL, TLS, SET-SNMP-System Security- Intrusion Detection, Password Management, Viruses and related threats, Firewalls-Wireless security-Wireless network security stack- WEP

Expected Outcome

In depth knowledge in

- Computer security techniques
- Modern cryptographic method

References

1. C. Kaufman, R. Perlman and M. Speciner, "Network Security: Private communication in a public World", 2/e, PHI, 2002.
2. W. Stallings, "Cryptography and Network Security Principles and practice", 3/e, Pearson Education Asia, 2003.
3. Roberta Bragg et.al "Network Security: The Complete Reference", TMH, 2008.
4. An Introduction to Mathematical Cryptography, Jill Pipher, Jeffrey Hoffstein, Joseph H. Silverman (Springer, 2008).

03 CS 6171- COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction: Security trends, security attacks, security mechanisms, Network Security model, cryptographic techniques – substitution - Affine Ciphers, Vigenere, Hill Cipher , Feistel Ciphers, one way functions and Trapdoor functions and the problem of breaking them. Transposition techniques. Differential and linear cryptanalysis, Steganography.	10	25
	FIRST INTERNAL EXAM		
II	Symmetric Key cryptography: Block cipher design principles and criteria, DES, IDEA, AES, RCS, Blowfish. Asymmetric key cryptography: Principles of public key crypto systems, RSA algorithm, Key Management, Diffie-Hellman key exchange, PKI – trust models, revocation, elliptic curve cryptography	10	25
III	Message Authentication and Hash functions: Authentication functions, message authentication codes, Hash functions and their security, MD5, SHA, RIPEMD Digital signatures and authentication protocols, Digital Signature standards, X.509 authentication service. Kerberos v4 – configuration, authentication, encryption, and message formats. Kerberos v5 – cryptographic algorithms, message formats	12	25
	SECOND INTERNAL EXAM		
IV	Email security- PGP, PEM, S/MIME, Network security – IPSec, Web security – SSL, TLS, SET Network management security: SNMP, Basic concepts of SNMPv1, SNMPv3. System Security- Intrusion Detection, Password Management, Viruses and related threats, Virus Counter measures, Firewalls-Design Principles, Trusted Systems. Wireless security: Wireless network security stack, WEP	10	25
	END SEMESTER EXAM		

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6181	**Grid Computing**	3-0-0		2015

Course Objectives

- To understand scope of grid computing and types of grid.
- To understand role of grid computing organizations.
- To understand the implementation technologies of grid computing.
- To understand the grid deployments in industry and research.

Syllabus

Grid computing model- Grid Protocols, Grid Computing Organizations and their roles, Grid Enabling Software Applications, Technologies: OGSA –Analogy for OGSA –OGSA Overview-Implementing OGSA based Grids-GT3 Toolkit. Managing Grid Environments, Grid Computing Applications: Adoption in Research and Industry, Life Sciences, Telecommunications Sector. Hive computing for Transaction Processing Grids.

Expected Outcome

1. Realize the business value.
2. Conceptual understanding of grid deployment and ability to apply them in practical solution.

References

1. Ahmar Abbas, "Grid Computing: A Practical Guide to technology and Applications", Charles River media – 2003.
2. Joshy Joseph & Craig Fellenstein, "Grid Computing", PHI, PTR-2003.
3. Ian Foster, Carl Kesselman, "The Grid2: Blueprint for a New Computing Infrastructure". Morgan Kaufman, New Delhi, 2004.
4. Fran Bermn, Geoffrey Fox, Anthony Hey J.G., "Grid Computing: Making the Global Infrastructure a Reality", Wiley, USA, 2003.
5. Maozhen Li, Mark Baker, "The Grid: Core Technologies", John Wiley & Sons, 2005.

03 CS 6181 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% Marks in End of Semester Examination**
I	Grid Computing: Introduction -Definition -Scope of grid computing. Grid computing model- Grid Protocols – Types of Grids. Desktop grids: Characteristics – key elements – Role in enterprise computing infrastructure. Data grids: Avaki Data Grid – Data grid Architecture.	12	25
FIRST INTERNAL EXAM			
II	Grid Computing Initiatives: Grid Computing Organizations and their roles – Grid Computing anatomy – Grid Computing road map. Grid Enabling Software Applications- Requirements of Grid Enabling Software-The Process of Grid Enabling Software-an example.	10	25
III	Technologies: OGSA –Analogy for OGSA –OGSA Overview-Implementing OGSA based Grids-GT3 Toolkit. Managing Grid Environments: Managing grids – management reporting – monitoring – service level management – Data catalogs and replica management.	10	25
SECOND INTERNAL EXAM			
IV	Grid Computing Applications: Adoption in Research and Industry, Life Sciences, Telecommunications Sector. Hive computing for Transaction Processing Grids.	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6191	**Digital Image Processing**	3-0-0	3	2015

Course Objectives

- To impart understanding of the issues and methodologies in digital image processing.

Syllabus

Image Processing System-Representation of Digital Images- Introduction to Fourier Transform. Image Enhancement-Histogram Processing Filters, Image Segmentation-Morphological operation-Edge Detection- Thresholding, Region based Segmentation. Color image Processing- Color Models, Color transformation. Compression- Video Motion Analysis –Image Fusion – Steganography.

Expected Outcome

- Student gets deeper understanding of principles and techniques and algorithms for digital image processing

References

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing" Third Edition, Pearson Education.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Person Education, 2003

03 CS 6191 - COURSE PLAN			
Module	**Contents**	**Hours**	**% Marks in End-of-Semester Examination**
I	Introduction-Image Processing System-Representation of Digital Images-Image formation model, Sampling and Quantization, Image Interpolation-Pixel Relationships- Color Fundamentals and models--Introduction to Fourier Transform.	**10**	25
FIRST INTERNAL EXAM			
II	Image Enhancement-Basic intensity Transformation functions-Histogram Processing-Histogram Equalisation, Histogram matching-Filtering-Smoothing filters, Sharpening filters-Filtering in frequency Domain-Smoothing filter and Sharpening filtering	**10**	25
III	Image Segmentation-Morphological operation-Erosion, Dilation, Opening and closing, Boundary Extraction, Connected Components, Thickening, Thinning-Edge Detection- Thresholding, and Region based Segmentation. Color image Processing- Color Models, Color transformation.	**12**	25
SECOND INTERNAL EXAM			
IV	Compression-Coding Redundancy, Image Compression models, Image formats-Compression methods-Huffman Coding , LZW coding-Applications- Image Understanding – Video Motion Analysis –Image Fusion – Steganography	**10**	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6201	**Cyber crime, Legal issues and Ethics**	3-0-0	3	2015

Course Objectives

- To understand the different types of cyber crimes and cyber laws in India and abroad
- To impart sufficient knowledge on the fundamental legal issues in internet archiving.
- To expose to ethical issues in today's computer based environment

Syllabus

Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime, cyber crime issues, Computer Ethics, Ethics and IT, Legal issues in Computer Information Systems, Legal issues in archiving internet resources-internet archiving, web archiving, understanding international security system, Evolution of Cyber law-Evolution of property rights, Legal measures to protect the integrity on the internet, The Information Technology Act 2000, regulation of certifying authorities, duties of subscribers, penalties and adjudication, the cyber regulations Appellate.

Expected Outcome

- Awareness of rules and regulations and of the laws applicable to computer and software related contracts.
- Exposure to different forms of Cyber crimes and the Indian and International laws to combat Cyber crimes and facilitate e-commerce.
- Capability to reason out different situations of ethics faced in the cyber world.

References

1. Cyber crime and Legal issues-Paul T Augastine-Crescent Publishing corporation, 2007.
2. Deborah G Johnson, Computer Ethics, Pearson Education Pub., ISBN: 81-7758-593-2.
3. Cyber crime and corporate liability- Rohas Nagpal, Kluwer publications, 2008.
4. Cyber crime-Prosecution and defence- Rohas Nagpal, Asian school of Cyber laws, 2008.
5. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009.
6. Bernadette H Schell, Clemens Martin, "Cybercrime", ABC – CLIO Inc, California, 2004.
7. Cyber crime investigation Manual- Rohas Nagpal, ASCL Academy 2008.
8. Cyber crime and Law enforcement-V.D. Dudeja, Common wealth Publishers, 2003.
9. Digital evidence and Computer crime- Eoghan Casey, academia Press, 2004.

03 CS 6201 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime: Social Engineering, Categories of Cyber Crime, cyber crime issues: Unauthorized Access to Computers, Computer Intrusions, White collar Crimes, Viruses and Malicious Code, Internet Hacking and Cracking, Virus Attacks, Child Pornography, Software Piracy, Intellectual Property, Mail Bombs, Exploitation ,Stalking and Obscenity in Internet Computer Ethics: Why Computer Ethics ,Ethics and IT, Ethics in IT configured Societies, activities, Domain of Life, Democracy and the Internet.	13	25
FIRST INTERNAL EXAM			
II	Computer information Systems, Legal issues in Computer Information Systems, Regulation of Computer crime, Computer information system content. Legal issues in archiving internet resources-internet archiving, web archiving, crime prevention in cyber space, support of victims in reporting computer crime, understanding international security system, Criminal intelligence and investigation practices, use of gathering police information ,factors for information and non information sharing and non sharing.	12	25
III	Evolution of Cyber law-Evolution of property rights**,** impacts of factors ,security of property rights, assurance problems, determinants of trust, reputation and recourse, dispute resolution of thirty party, customary law, polycentric governance, institutional developments in cyber space, benefits of polycentric customary law.	11	25
SECOND INTERNAL EXAM			
IV	Legal measures to protect the integrity on the internet-use of agent technology, Agent platforms, upcoming issues, procedural laws, coercive powers of prosecuting authorities, search and seizure, active cooperation, Wire tapping and eavesdropping on computer systems, problems in personal data, tolerability of computer generated evidence, harmonization of Cyber laws, The Information Technology Act 2000-Definitions,secure digital signature, Secure Electronic records, regulation of certifying authorities, duties of subscribers, penalties and adjudication, the cyber regulations Appellate. Latest amendments.	13	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 RM 6001	**Research Methodology**	1-1-0	2	2015

Course Objectives

- This course is designed to familiarize the student with the research process, problem identification strategies and formulation of a research plan by doing case studies.

Syllabus

Introduction to Research Methodologies -Objectives -motivation in research- Significance of research - interaction between industries and research units –research and innovation.

Research Formulation- Literature review Ethics in research: – copy right – plagiarism –citation acknowledgement- Research Design -and report writing.

Case Studies : Department / stream specific case study and preparation of a research plan or a review paper

Expected Outcome

- Students will be able to write a review paper after critically evaluating the state of the art development in a topic of interest.
- Students will acquire capability to write a research proposal in the form of a technical paper which could lead the student towards his / her final thesis topic.
  - **No formal end semester examination is intended – Evaluation is based on internal oral presentations and a Technical Report or a Research Plan or a Review Paper**

References

1. R. Paneersalvam, "Research Methodology",Prentice Hall of India Pvt. Ltd.,2011
2. Mike Martin, Roland Schinzinger, "Ethics in Engineering" ,McGraw Hill Education, Fourth Edition,.2014
3. Vinod V Sople," Managing Intellectual Property-The Strategic Imperative, EDA", Prentice of Hall Pvt. Ltd.,2014
4. Kothari C R &Gaurav Garg – "Research Methodology- Methods and Techniques",New Age International(P) Ltd Publications,2006
5. Day A Robert,"How to write and publish a scientific paper",Cambridge University,UK,2012
6. Leedy P D,"Practical Research-Planning and Design", Prentice Hall of India Pvt. Ltd.

03 RM 6001 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction –Need for research-objectives and motivations in research. Significance of research - -need for interaction between academic institutions, industrial and research establishments – research and innovation. Research Formulation- Identifying a research problem- - literature review– confirming to a research problem based on literature review**.**	**4**	25
FIRST INTERNAL EXAM			
II	Research Ethics – Environmental impacts – Ethical issues – Intellectual Property Rights – Patents – legal formalities in filing patent in India – Copy right– plagiarism – citation and acknowledgement.	3	25
III	**Research design** –Prepare research plan. **Report writing** – types of report – research report, research proposal, funding agencies for research concerned to the specialization, significance of peer reviewed articles and technical paper- - simple exercises - oral presentation	3	
SECOND INTERNAL EXAM			
IV	**Case Studies** The student is expected to **prepare a research plan** relating to a topic of current interest in the concerned specialization, which has appeared in a recent journal. A minimum of 20 related referred articles should be critically studied. On the basis of this, the student is expected to prepare a review report/paper of publishable quality. **This paper has to be presented for open defence before the departmental committee. (This would carry 50% marks)**	6	50
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6901	**Seminar I**	0-0-2	2	2015

Course Objectives

To make students,

- identify a domain of interest
- identify sufficient number of latest good quality research papers on a particular problem or allied problems
- do extensive study and analysis of the problem and solution(s)
- prepare a comprehensive report
- make a presentation of 30 minutes based on the topic

Seminar Guidelines

- No specific Syllabus
- Each student shall individually prepare and present a seminar and the topic should be relevant to the stream of study with content suitable for M.Tech level Presentation.
- For selection of topics refer internationally reputed transactions/journals. The primary reference should be published during the last two or three years.
- A detailed write-up /synopsis should be prepared in the prescribed format given by the Department and get the topic approved by the PG Coordinator well in advance.
- The seminar shall be of 30 minutes duration and a committee, with the PG Co-ordinator as the chairman and two faculty members from the department as members shall evaluate the seminar based on the technical content, presentation, depth of knowledge and ability to answer the questions put forward by the committee.
- After the completion of the Seminar work the students would be required to submit two copies of the seminar reports prepared by them in the prescribed format.

Expected Outcome

To student

- gets good exposure to a domain of interest and the research problems in the domain
- gets practice in the art of doing literature survey
- improves his/her writing and presentation skills

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6821	**Algorithm Design Lab using C/ C++/ Java**	0-0-2	1	2015

Syllabus

Experiments are based on but not limited to the topics covered in 03 CS 6151: Advanced Data Structures and Algorithms.

03 CS 6821 – EXPERIMENTS

Experiment No	Description	Hours Allotted
I	Construct a Binary search tree and perform its traversals.	2
II	Implement Min/Max Heap and perform (Insertion, Delete min/Delete Max) operations.	4
III	Implement a Binomial heap.	2
IV	Implement any primality testing algorithm to check given no is prime or not.	4
V	Implement Ford Fulkerson method.	4
VI	Implement maximum bipartite matching.	2
VII	Implement Longest Common Subsequence problem.	2
VIII	Implement Matrix chain multiplication	2
IX	Implement Rod cutting problem.	2
X	Implement Vertex Cover Problem.	2
XI	Implement Geometric algorithm to find out convex hull.	2

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6172	**Advanced Operating Systems**	4-0-0	4	2015

Course Objectives

- To understand the configuration and functions of a typical OS Kernel
- To have an overview on concepts implemented in modern operating systems.

Syllabus

Introduction to the Linux kernel - Process Management – Linux implementation of threads – Process scheduling –Policy – Linux scheduling algorithms –Preemption & context switching,- system calls, Memory Management - Kernel Synchronization-Critical Regions and Race Conditions, Locking, Deadlocks, Contention and Scalability. Kernel Synchronization Methods –Interrupts and Interrupt Handlers - Registering an Interrupt Handler, Writing an Interrupt Handler-Bottom Halves – Task Queues, Softirqs, Tasklets, Work Queues-Distributed OS, Introduction to communication primitives – ATM, client server model & RPC, Synchronization in distributed system – Deadlock in distributed system-Process & processor in distributed system – threads – system models – processor allocation-Scheduling in distributed system – Fault tolerance, Distributed file system – design & implementation. Case Study : Amoeba, Mobile OS: Android, Ios

Expected Outcome

In-depth knowledge in Design and implementation of Kernel modules.

References

1. A .S .Tanenbaum, “Distributed Operating systems”, PHI.
2. M. Singhal and N.G. Sivarathri, “Advanced Concepts in Operating Systems”, M. C. Grawhill Inc. 1994.
3. Robert Love, “Linux Kernel Development”, 3/e, Addison-Wesley, 2010.
4. Daniel Bovet, Marco Cesati, “Understanding the Linux Kernel”, 3/e, OReilly Media Inc,2005.
5. William Stallings, "Operating Systems" ,Fourth Edition, Pearson Education, 2004
6. A. S. Tanenbaum, “Modern Operating Systems”, PHI Edition, 1992

03 CS 6211 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction to the Linux kernel – History – Advantages – versions, Process Management – Process – Process descriptor & task structure – process state – Process creation –Process termination – Linux implementation of threads – kernel threads, Process scheduling –Policy – Linux scheduling algorithms –Preemption & context switching,- system calls, Memory Management - Pages and Zones, Slab Layer, Static Allocation on the Stack, High Memory Mappings, Per-CPU Allocations.	14	25
FIRST INTERNAL EXAM			
II	Kernel Synchronization-Introduction, Critical Regions and Race Conditions, Locking, Deadlocks, Contention and Scalability. Kernel Synchronization Methods – Atomic Operations, Spin Locks, Semaphores, Mutexes, Completion Variables, BKL: The Big Kernel Lock Sequential Locks, Preemption Disabling. Interrupts and Interrupt Handlers - Registering an Interrupt Handler, Writing an Interrupt Handler, Interrupt Context, Interrupt Control, Bottom Halves – Task Queues, Softirqs, Tasklets, Work Queues.	16	25
III	Distributed OS: Introduction – Design Issues, Introduction to communication primitives – ATM, client server model & RPC, Synchronization in distributed system – clock synchronization-logical clock, physical clock, clock synchronization algorithm, Mutual exclusion, Election algorithm, and Atomic transactions. Deadlock in distributed system- distributed deadlock detection, prevention.	14	25
SECOND INTERNAL EXAM			
IV	Process & processor in distributed system – threads – system models – processor allocation. Scheduling in distributed system – Fault tolerance, Distributed file system – design & implementation. Case Study: Amoeba, Mobile OS: Android, ios.	12	22
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6182	**Modern Computer Networks**	3-0-0	3	2015

Course Objectives

- To impart a deeper understanding of
  - Networking design including media, protocols, quality control and congestion management.
  - Multimedia networking issues and approaches.

Syllabus

Networking Basics: Transport Protocols, Packet Switching Networks, and High Speed LAN's. Congestion and Traffic Management: Congestion Control in Data Networks and Internets, Link Level Flow and Error Control, TCP Traffic Control, Asynchronous Transfer Mode (ATM), Traffic and Congestion Control in ATM Network. Routers: Addressing, Routing, Advanced Features of IP Routers, Quality of services in IP Networks, Integrated and Differentiated Services. Multimedia Networking Applications: Audio and Video Compression Techniques. Streaming Stored Audio/ Video, Streaming Live Audio/ and Video. Protocols for Real–Time Interactive Applications.

Expected Outcome

- The student becomes aware of the theoretical and practical issues in networking.

References

1. William Stallings, "High Speed Networks and Internets – Performance and Quality of Service", Pearson India 2005.
2. Natalia Olifer Victor Olifer," Computer Networks - Principles, Technologies and Protocols for Network Design", - Wiley India (P) ltd. 2006.
3. James F Kurose and Keith W Ross," Computer Networking- A Top Down Approach Featuring Internet", 3/e, Pearson Education.
4. Kurose and Ross, "Computer Networks A systems approach", Pearson Education.
5. Behrouz A Forouzan, "TCP/IP Protocol Suite", Tata McGraw-Hill.
6. Behurouz A Forouzan, "Data Communications and Networking", 4/e, McGraw-Hill.
7. William Stallings, "Data and Computer Communications ", 3/e,Pearson Education
8. A. S. Tanenbaum, "Computer Networks", 5/e, Prentice Hall India.

03 CS 6182 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Networking Basics: Transmission Control Protocol (TCP), User Datagram Protocol, The Internet Protocol (IPV4 and IPV6). Packet Switching Networks- X.25, Frame Relay. High Speed LAN's- High Speed Ethernet, Fibre Channel, Wireless LAN's.	10	25
FIRST INTERNAL EXAM			
II	Congestion and Traffic Management: Congestion Control in Data Networks and Internets, Link Level Flow and Error Control, TCP Traffic Control, Asynchronous Transfer Mode (ATM), Traffic and Congestion Control in ATM Network.	10	25
III	Routers: Addressing – Flat, Classless, Hierarchical, Multicast, Anycast. Routing- Interior and Exterior Routing Protocols. Advanced Features of IP Routers- Filtering, NAT. Quality of services in IP Networks- Integrated and Differentiated Services. Protocols for QoS Support.	12	25
SECOND INTERNAL EXAM			
IV	Multimedia Networking Applications: Audio and Video Compression Techniques – Information Theory, Lossless Compression, Lossy Compression. Streaming Stored Audio/ Video, Streaming Live Audio/ and Video. Protocols for Real–Time Interactive Applications.	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6192	**Advanced Database Management Systems**	3-0-0	3	2015

Course Objectives

- To understand the implementation and management aspects of databases.
- To understand the principles of spatial databases.
- To understand the relevance of mobile databases.
- To understand the emerging technologies in databases.

Syllabus

Database system concepts and architecture-Query Processing Algorithms – Query Optimization Techniques. Distributed databases– Distributed Transactions - Concurrency Control –Deadlocks – Recovery - distributed query processing- Spatial Data Management-Mobile Databases- Mobile Transaction Models -Concurrency Control Mechanism-Transaction Commit Protocols- Mobile database Recovery-Multimedia Databases. Web Databases-Cloud Databases- Graph databases-Case Study-Google's Spanner

Expected Outcome

- Ability to use query optimization and transaction processing concepts
- Conceptual understanding of spatial databases.
- Conceptualize the new possibilities of mobile database.
- Knowing how best emerging trends can be used in databases.

References

1. Elmasri R., Navathe S.B., "Fundamentals of Database Systems", Pearson Education/Addison Wesley, Fifth Edition, 2007.
2. Henry F Korth, Abraham Silberschatz, Sudharshan S., "Database System Concepts", McGraw Hill, Fifth Edition, 2006.
3. Serge Abiteboul, IoanaManolescu, Philippe Rigaux, Marie -Christine Rousset, Pierre Senellart, Web Data Management, Cambridge University Press, 450 pages,2011. (Also available online)
4. Bhavani Thuraisingham, XML Databases and the Semantic Web, CRC Press, 2002.
5. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", 3/e, Pearson Education, 2010.
6. SQLite, From Wikipedia, the free encyclopedia, http://en.wikipedia.org/wiki/SQLite
7. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", McGraw Hill, Third Edition, 2004. 7. Dale Anderson, Big Data and NoSQL Technologies at

http://dbbest.com/blog/big-data-nosql-technologies/

8. Dale Anderson, Column Oriented Database Technologies at http://dbbest.com/blog/column-oriented-database-technologies/
9. Big Table and Column Databases, Ling Liu, College of computing http://www.cc.gatech.edu/~lingliu/courses/cs4440/notes/17.BigTableColumnDB.pdf
10. Fay Chang, Jeffrey Dean, Sanjay Ghemawat, Wilson C. Hsieh, Deborah A. Wallach Mike Burrows, Tushar Chandra, Andrew Fikes, Robert E. Gruber, Bigtable: A Distributed Storage System for Structured Data at http://static.googleusercontent.com/ external_content /untrusted_dlcp/research.google.com/en//archive/bigtable-osdi06.pdf
11. Graph databases- Ian Robinson, Jim Webber, Emil Eifrem, and O'Reilly 12. Klint Finley, 5 *Graph Databases* to Consider at http://readwrite.com/2011/04/20/5-graph-databases-to-consider.
12. Vijay Kumar, "Mobile Database Systems", a John Wiley & Sons, Inc., Publication.

03 CS 6192 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction: Database and database users – Database system concepts and architecture-Query Processing Algorithms – Query Optimization Techniques. Distributed databases: Functions- Distributed RDB design- Transparency– Distributed Transactions - Commit Protocols– Concurrency Control –Deadlocks – Recovery - distributed query processing.	8	25
FIRST INTERNAL EXAM			
II	Advanced databases: Spatial Data Management: Types Of Spatial Data and Queries- Point and Region Data-Queries-Applications Involving Spatial Data -Spatial Indexes-indexing using Space Filling Curves-Region Quad Trees and Z Ordering – Index Structures - Grid Files, Rtrees	10	25
III	Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Database Systems – Transaction Execution in MDS- Mobile Transaction Models -Concurrency Control Mechanism-Transaction Commit Protocols- Mobile database Recovery: Log management in mobile database systems - Mobile database recovery schemes	12	25
SECOND INTERNAL EXAM			
IV	Emerging Technologies: Multimedia Databases. Web Databases: NoSQL Databases-Semi-structured data management-XML, XPath and XQuery. Cloud Databases: methods to run- virtual machine deployment, as a service- Cassandra, HBase-Aggregation and Join. Graph databases: Comparison of Twitter's FlockDB and Neo4j- Overview of NewSQL .Case Study-Google's Spanner	12	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6202	**Cloud Computing**	3-0-0	3	2015

Course Objectives

- To understand the cloud services and compare with existing technologies.
- To understand the cloud deployment and security.

Syllabus

Definition and History of Cloud Computing –How Cloud Computing Works? – Advantages and Disadvantages of Cloud Computing - Cloud Services– Types of Service Models, Web Services- Cloud Architecture –Jericho Cloud cube Model, Cloud Deployment Models- Private -Public-Hybrid-Community. Cloud Resource Virtualisation- Virtual Machine-VMM-Full virtualisation and Para virtualisation-Hardware Support for virtualisation- Darker side of virtualisation, Migrating to the cloud: The Seven-Step Model of Migration into a Cloud-Cloud security-Cloud computing security architecture-Trusted Cloud computing, Identity Management and Access control, Autonomic Security. Data in cloud: Cloud File Systems, BigTable, HBase, Dynamo and Cloud Data Stores: DataStore and Simple DB. Case studies and feature comparison: IAAS and PAAS offerings, Companies in the cloud today-Amazon EC2 – Google App Engine – Microsoft Azure, IBM clouds, mobile clouds.

Expected Outcome

- Ability to design and develop cloud services.
- Use Cloud Service and collaborate it with various applications.

References

1. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
2. Sosinsky B., "Cloud Computing Bible", Wiley India.
3. Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper," Cloud Computing for Dummies" (Wiley India Edition).
4. Antohy T Velte, et.al ,"Cloud Computing : A Practical Approach," McGraw Hill,
5. Gautam Shroff "Enterprise Cloud Computing",Cambridge university press
6. Ronald Krutz and Russell Dean Vines," Cloud Security-a comprehensive guide to secure cloud Computing, Wiley-India
7. Tim Malhar, S. Kumaraswammy, S. Latif ,"Cloud Security & Privacy ", (SPD,O'REILLY)
8. Buyya R., Broberg J., Goscinski A., "Cloud Computing : Principles and Paradigm", John Wiley & Sons
9. Cloud Computing: Theory and Practice (Google eBook) Dan C. Marinescu.
10. Cloud Computing Virtualization Specialist Complete Certification Kit - Study Guide Book and online Course - Second Edition" (Google eBook) Ivanka Menken

03 CS 6202 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Understanding cloud computing: Definition and History of Cloud Computing –How Cloud Computing Works? – Advantages and Disadvantages of Cloud Computing – Users of Cloud Computing. Cloud Services- Pros and Cons of Cloud Service Development – Types of Service Models – Software as a Service – Platform as a Service – Infrastructure as a service, Web Services – On-Demand Computing.	10	25
FIRST INTERNAL EXAM			
II	Cloud Architecture –Jericho Cloud cube Model, Cloud Deployment Models- Private -Public-Hybrid-Community. Cloud Resource Virtualisation- Basics-Layering-Virtual Machine-VMM-Full virtualisation and Para virtualisation- Hardware Support for virtualisation- Darker side of virtualisation, Migrating to the cloud: The Seven-Step Model of Migration into a Cloud.	12	25
III	Cloud security- Cloud computing security challenges: Security Policy implementation, CSIRT. Cloud computing security architecture: Architectural Considerations- General Issues, Trusted Cloud computing, Identity Management and Access control, Autonomic Security. Data in cloud: Cloud File Systems, BigTable, HBase, Dynamo, and Cloud Data Stores: DataStore and Simple DB.	12	25
SECOND INTERNAL EXAM			
IV	Case studies and feature comparison: IAAS and PAAS offerings, Companies in the cloud today-Amazon EC2 – Google App Engine – Microsoft Azure, IBM clouds, mobile clouds.	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6212	**Advanced Wireless Networks**	3-0-0	3	2015

Course Objectives

- To understand the theory and applications of various advancements in wireless networks.

Syllabus

Wireless Area Networks: WiMAX; WLAN; Bluetooth; Radio Frequency Identification; Wireless and mobile Internet; MobileIP-IPv6, TCP in Wireless Domain, Mobile Internet connectivity: WAP1.1; Layers of WAP; WAE; WML; WML script; WTA; PUSH architecture; PUSH/PULL services; Wireless Sensor Network various aspects enabling technologies for sensor network and applications - ZIGBEE standard and architecture -WBAN standard and architecture; Emerging Technologies**:** Introduction to NFC, DASH7, RuBee, EnOcean, Cognitive Radio. WB Radio Communication: Fundamentals of UWB - meghadoot architecture - 802.11VoIP phone - IEEE 802.11n; LTE: LTE FDD vs TDD.

Expected Outcome

- The student should have a clear idea regarding the basic networking trends as well as the emerging technologies in wireless network

References

1. Kaveh Pahlavan and Prashant Krishnamurthy, “Principle of Wireless Networks - A Unified Approach”, Prentice Hall of India, 2006.
2. William Stallings, “Wireless Communication and Networks”, 2nd Edition, Prentice Hall, 2005.
3. Clint Smith and Daniel Collins, “3G Wireless Networks”, 2nd Edition, Tata McGraw Hill, 2007.
4. Vijay K.Garg, “Wireless Communications and Networks”, 2nd Edition, Morgan Kaufmann Publishers (Elsevier), 2007.
5. Amitabha Ghosh and Rapeepat Ratasuk, “Essentials of LTE and LTE-A,” Cambridge University, 2011.
6. Guillaume De La Roche, Andres Alayon Glazunov and Ben Allen, “LTE – Advanced and Next Generation Wireless Networks: Channel Modelling and Propagation”, John Wiley and Sons Ltd., 2012.
7. Hossam S. Hassanein, Abd-Elhamid M. Taha, Najah Abu Ali, “LTE, LTE-Advanced, and WiMAX: Towards IMT-Advanced Networks”, John Wiley and Sons Ltd., 2012.

03 CS 6212 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Wireless Area Networks: WiMAX: BWA - network architecture - protocol stack of IEEE 802.16 - physical layer, MAC layer schemes - differences between IEEE 802.11 and IEEE 802.16; WLAN: Fundamentals - technical issues - network architecture - protocol stack of IEEE 802.11 - physical layer, MAC layer mechanism; Bluetooth: Network architecture - operation-protocol stack - specification and application models; Radio Frequency Identification (RFID): Types and specifications.	11	25
FIRST INTERNAL EXAM			
II	Wireless and mobile Internet: Introduction: Mobile IP - IPv6 advancements - mobility management - functions - location management - registration and handoffs - wireless security and standards; TCP in Wireless Domain: TCP over wireless - types - traditional - snoop - indirect - mobile - transaction - oriented - impact of mobility. Mobile Internet connectivity: WAP1.1, Layers of WAP, WAE, WML, WML script, WTA, PUSH architecture, PUSH/PULL services.	11	25
III	Wireless Sensor Network: Issues - design challenges - characteristics and architecture of wireless sensor network - layered and clustered - data dissemination - data gathering - MAC protocols for sensor networks Location discovery - security - enabling technologies for sensor network and applications - comparisons with MANET - ZIGBEE standard and architecture -WBAN standard and architecture.	10	25
SECOND INTERNAL EXAM			
IV	Emerging Technologies: Introduction to NFC, DASH7, RuBee, EnOcean, Cognitive Radio.UWB Radio Communication: Fundamentals of UWB - major issues - operation of UWB systems -advantages and disadvantages; Multimode 802.11 - IEEE 802.11a/b/g - software radio based multimode system - meghadoot architecture - 802.11VoIP phone - IEEE 802.11n; LTE: System architecture – transmission scheme - frame structure - analysis of link and system level performance - LTE FDD vs TDD.	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6222	**Adhoc and Sensor Networks**	3-0-0	3	2015

Course Objectives

- To know the constraints of the wireless physical layer that affect the design and performance of ad hoc and sensor networks, protocols, and applications;
- To understand MAC, Routing protocols that have been proposed for ad hoc and sensor networks
- To understand the energy issues in sensor networks and how they can be addressed using scheduling, media access control, and special hardware;
- To explain various security threats to ad hoc networks and describe proposed solutions

Syllabus

Overview of Wireless LAN, PAN - IEEE 802.11- Bluetooth - Wireless WANs and MANs – Cellular Architecture- WLL - IEEE 802.16 - Wireless Internet - IP and TCP in Wireless domain.AD HOC Wireless Networks - Cellular and Ad hoc networks - Applications of Ad hoc networks - Issues in Ad hoc networks - MAC protocols for Ad hoc networks. Routing Protocols for Ad hoc Networks - Classification - Table driven, On demand, Hierarchical Routing Protocols- Energy Management in Ad hoc Networks. Emerging trends in Ad hoc Networks - Mobility models for Ad hoc Networks. Wireless Sensor Networks - Architecture - Data Dissemination and Gathering - Location Discovery - Applications of WSNs – Operating system and programming for Sensor Network Security - Ultra Wideband Systems - Hybrid Wireless Networks

Expected Outcome

In depth knowledge in multicast routing algorithms, mobility and its impact on routing protocols, application performance, quality of service guarantees, and security.

References

1. Wireless Networks: Anurag Kumar, D. Manjunath, Joy Kuri, (1st Ed.), Morgan Kaufman (2008)
2. Ad Hoc Wireless Networks: Architectures and Protocols, C. Siva Ram Murthy and B. S. Manoj, (2nd Ed.),Pearson Education (2005)
3. Ad Hoc & Sensor Networks: Theory and Applications, Carlos de Morais Cordeiro and Dharma Prakash Agrawal, (1st Ed.), World Scientific (2007)
4. Algorithms and Protocols for Wireless Sensor Networks: Azzedine Boukerche (Edited volume), Wiley-IEEE press (2008)
5. Wireless Sensor Networks (1st Ed.), Ian F. Akyildiz nad and Mehmet Can Vuran, Wiley-IEEE press (2010)
6. Wireless sensor network, Kazem shorbay, Daniel Minoli and Taieb znati (1st Ed.), Wiley-IEEE press (2007).

03 CS 6222– COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Overview of Wireless LAN, PAN - IEEE 802.11- Bluetooth - Wireless WANs and MANs – Cellular Architecture- WLL - IEEE 802.16 - Wireless Internet - IP and TCP in Wireless domain.	10	25
FIRST INTERNAL EXAM			
II	ADHOC Wireless Networks - Cellular and Ad hoc networks - Applications of Ad hoc networks - Issues in Ad hoc networks - MAC protocols for Ad hoc networks	10	25
III	Routing Protocols for Ad hoc Networks - Classification - Table driven, On demand, Hierarchical Routing Protocols- Energy Management in Ad hoc Networks. Emerging trends in Adhoc Networks - Mobility models for Ad hoc Networks	12	25
SECOND INTERNAL EXAM			
IV	Wireless Sensor Networks - Architecture - Data Dissemination and Gathering - Location Discovery - Applications of WSNs – Operating system and programming for Sensor Network Security - Ultra Wideband Systems - Hybrid Wireless Networks.	12	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6232	**Big Data Processing**	3-0-0	3	2015

Course Objectives

- To understand the data processing in various medium.

Syllabus

Big Data and Hadoop- Big data meets hadoop- Core components-Developing enterprise applications. Data Storage-HDFS- HDFS Architecture-Applicability of HDFS-Using HDFS files-Hadoop specific file types-HDFS federation and high availability. HBase-High Level HBase Architecture-HBase schema design-New HBase Features-Managing metadata with HCATALOG. Data Processing- MapReduce- Execution pipeline-Designing MapReduce implementations-Using MapReduce as a framework for parallel processing-Face Recognition Example-Simple Data Processing with MapReduce-Inverted Indexes Example-Building joins with MapReduce-Road Enrichment Example-Link Elevation Example-Building iterative MapReduce Applications-To MapReduce or not to MapReduce?-Common MapReduce Design Gotchas. Hive-Features - Hive architecture –Hive in the hadoop ecosystem – Datatypes and file formats –primitive and collection datatypes – HiveQL–databases in Hive – Creating, Altering, Partitioning and managing tables. Pig-Features and uses- Comparison with Map-Reduce-Pig Latin commands. Spark-Spark Architecture-Spark Streaming-Streaming Operator-Spark SQL-Resilient Distribution Dataset (RDD). Hadoop distributions-Cloudera-Horton Work's sandbox-MapR.

Expected Outcome

- In depth knowledge in hadoop, spark etc

References

1. Boris Lublinsky Kevin T. Smith Alexey Yakubovich ,PROFESSIONAL Hadoop Solutions
2. Tom White ,"Hadoop: The Definitive Guide", O'Reilly Media 3rd Edition,May6, 2012
3. Chuck Lam , "Hadoop in Action" ,Manning Publications; 1st Edition ,December, 2010
4. Donald Miner, Adam Shook, "MapReduce Design Patterns", O'Reilly Media, November 22, 2012.
5. Edward Capriolo, Dean Wampler, Jason Rutherglen, "Programming Hive", O'Reilly Media; 1st edition , October, 2012.
6. Alan Gates, "Programming Pig", O'Reilly Media; 1st Edition, October, 2011.
7. Snehalatha, Scheduling Workflows using Oozie Coordinator, DeveloperIQ Magazine, August28, http://developeriq.in/articles/2013/aug/28/scheduling-workflows-using-oozie-coordinator/.
8. Spark Streaming, Data-Intensive systems: Real-Time Stream Processing, Duke University Department of Computer Science 2012 at http://www.cs.duke.edu/~kmoses/cps516/dstream.html.

03 CS 6232 – COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Big Data and Hadoop- Big data meets hadoop- Core components-Developing enterprise applications. Data Storage-HDFS- HDFS Architecture-Applicability of HDFS-Using HDFS files-Hadoop specific file types-HDFS federation and high availability. HBase-High Level HBase Architecture-HBase schema design-New HBase Features-Managing metadata with HCATALOG.	14	25
FIRST INTERNAL EXAM			
II	Data Processing**-** MapReduce- Execution pipeline-Designing MapReduce implementations-Using MapReduce as a framework for parallel processing-Face Recognition Example-Simple Data Processing with MapReduce-Inverted Indexes Example-Building joins with MapReduce-Road Enrichment Example-Link Elevation Example-Building iterative MapReduce Applications-To MapReduce or not to MapReduce?-Common MapReduce Design Gotchas.	12	25
III	Hive**-**Features - Hive architecture –Hive in the hadoop ecosystem – Datatypes and file formats –primitive and collection datatypes – HiveQL–databases in Hive – Creating, Altering, Partitioning and managing tables. Pig**-**Features and uses- Comparison with Map-Reduce-Pig Latin commands.	10	25
SECOND INTERNAL EXAM			
IV	Spark**-**Spark Architecture-Spark Streaming-Streaming Operator-Spark SQL-Resilient Distribution Dataset (RDD). Hadoop distributions-Cloudera-Horton Work's sandbox-MapR.	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6242	**Data Compression**	3-0-0	3	2015

Course Objectives

- Develop theoretical foundations of data compression, concepts and algorithms for lossy and lossless data compression, signal modelling and its extension to compression with applications to speech, image and video processing.

Syllabus

Basic Compression Techniques, Comparison of compression algorithms, Implementation of compression algorithms., Image Compression, Video Compression, Speech Compression & Synthesis.

Expected Outcome

- Awareness about various data compression techniques and their practical significance.
- Ability to apply techniques in practical scenarios.

References

1. "Data compression - The complete Reference", David Salomon, Springer Publications (4th Edition), 2006.
2. "The Data compression Book", Mark Nelson and Jean-Loup Gailly, Mark Nelson and Jean-Loup Gailly, BPB publications (2nd Edition),1995
3. "Introduction to Data Compression", Khalid Sayood, Harcout India(P) Ltd,2/e ,New Delhi,2002
4. Stephen Welstead, Fractal and wavelet Image Compression techniques , PHI, 1999

03 CS 6242 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction to compression techniques - Lossy compression & Lossless compression. Mathematical modelling for Lossless compression- Physical models, probability models, Markov Models and composite source models. Mathematical modelling for Lossy compression - physical models, Probability models and linear systems models..	10	25
FIRST INTERNAL EXAM			
II	Different Methods of Compression -Basic Techniques: Run length encoding, RLE Text compression, RLE image compression and scalar quantization. Statistical Methods: Information theory concepts, Huffman coding, Adaptive Huffman coding, Arithmetic coding and Adaptive Arithmetic coding and Text compression. Dictionary methods: String compression, LZ 77, LZSS, LZ78 and LZW.	10	25
III	Image Compression, Transform based techniques, Wavelet Methods, adaptive techniques. Images standards, JPEG Compression, Zig Zag Coding , Vector quantization, Adaptive Vector Quantization, Block Matching, Block Truncation coding. Block Decomposition, Binary Tree predictive coding, Quad Trees.	10	25
SECOND INTERNAL EXAM			
IV	Video Compression -Analog Video, Composite and Components Video, Digital Video, MPEG and H.261. Audio Compression -Sound, Digital Audio, The Human Auditory System, μ -Law and A-Law companding, ADPCM Audio compression and MPEPG-1 Audio Layers.	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6252	**Social Network Analytics**	3-0-0	3	2015

Course Objectives

- To understand the concept of social network and its parameters

Syllabus

Graphs:-Emperical study of social network, Vertex or node, edge, neighbours, degree, path, tree, bipartite graphs, directed graphs, weighted graphs, adjacency matrix, random graph.
Network: - *Types of Networks*-Full, Partial and Egocentric Network-Unimodal, Multimodal and Affliation Network, Multiplex Network, Spatial Dyadic Networks; *Network Data Representation* – Matrix-Edge List. S*ocial networks*- face book, movie collaboration, paper collaboration, I*nformation networks* (web).Social Media Defined:- Design Framework for Social Networks- Social Media Examples. Tie Strength:-Triadic Closure-Strength of Weak Ties- -Strong and Weak ties Network Centrality Measures- Degree of Centrality- Betweeness Centrality, Closeness Centrality- Eigen vector centrality- Katz Centrality- Transitivity- Reciprocity. Random models of networks: - Erdos-Renyi model of random graph, Problem with random graph. Small World Phenomenon: - Shortest path and small world effect, Small world model, Six Degrees of Separation. Web Analytics 2.0 paradigm:- Click stream Analysis – Eight critical web matrices – Bounce rate – Exit rate – Conversion rate – Engagement – Attributes of great metrics – Measuring Outcome :- Key Performance Indicators(KPIs)–– Measuring Macro and Micro Conversions – Measuring Success for a Non-ecommerce Website . Epidemics in Social Networks:-Diseases and the Networks that Transmit them, Branching Processes, The SI Epidemic Model, The SIR Epidemic Model, The SIS Epidemic Model, The SIRS Epidemic Model. Tools for analyzing Social Networks:- NodeXL, UCINET- Analyzing Face book using UCINET, Touch Graph, Net Logo- simulating social interactions with Net Logo, Gephi.

Expected Outcome

- Upon successful completion of this course the students can analyze social media and networking data with tools

References

1. Networks, Crowds and Markets, Reasoning about a Highly Connected World by David Easley and Jon Klienberg; Cambridge University Press 2010
2. Analyzing Social Media Networks with Node XL, Derek L Hansen, Ben Shneiderman, Marc A. Smith;Morgan Kaufmann, 2011
3. Avinash Kaushik. 2009. Web Analytics 2.0; Wiley Publishing, Inc, 2010.
4. Networks: An introduction, Mark Newman; Oxford University Press 2010.

03 CS 6252 - COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Graphs:-Emperical study of social network, Vertex or node, edge, neighbors, degree, path, tree, bipartite graphs, directed graphs, weighted graphs, adjacency matrix, random graph. Network:- *Types of Networks*-Full, Partial and Egocentric Network-Unimodal, Multimodal and Affliation Network, Multiplex Network, Spatial Dyadic Networks; *Network Data Representation* – Matrix-Edge List**.** S*ocial networks***-** face book, movie collaboration, paper collaboration, I*nformation networks* (web).Social Media Defined :- Design Framework for Social Networks-Social Media Examples	12	25
FIRST INTERNAL EXAM			
II	Tie Strength :-Triadic Closure**-**Strength of Weak Ties- **-**Strong and Weak ties, Network Centrality Measures- Degree of Centrality- Betweeness Centrality, Closeness Centrality- Eigen vector centrality- Katz Centrality- Transitivity- Reciprocity. Random models of networks **:-** Erdos-Renyi model of random graph, Problem with random graph Small World Phenomenon **:-** Shortest path and small world effect**,** Small world model, Six Degrees of Separation	10	25
III	Web Analytics 2.0 paradigm**:-** Click stream Analysis – Eight critical web matrices – Bounce rate – Exit rate – Conversion rate – Engagement – Attributes of great metrics – Measuring Outcome **:-** Key Performance Indicators(KPIs)–– Measuring Macro and Micro Conversions – Measuring Success for a Non-ecommerce Website	12	25
SECOND INTERNAL EXAM			
IV	Epidemics in Social Networks**:-**Diseases and the Networks that Transmit Them ,Branching Processes ,The SI Epidemic Model, The SIR Epidemic Model, The SIS Epidemic Model ,The SIRS Epidemic Model Tools for analyzing Social Networks:- NodeXL, UCINET- Analyzing Face book using UCINET, Touch Graph, Net Logo- simulating social interactions with Net Logo, Gephi.	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6902	Mini Project	0-0-4	2	2015

Course Objectives

The student is expected to do implementation of a sufficiently complex tool or application that demonstrates the significance of any theoretical concept or concepts (or problem or problems) he/she learned in the first or second semester. The work will be supervised and evaluated by a faculty member.

Syllabus

.

- The topic of mini project should be related to the area of specialization.

Expected Outcome

The student gains in-depth knowledge in the concept/problem he/she has undertaken and allied topics. It is essential to submit a clear and concise report that reflects the literature survey, problem identification, project aims and objectives, the engineering design work carried out, tests performed, analysis and discussion of results.

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 6822	**Operating Systems and Networking Lab**	0-0-2	1	2015

Syllabus

Experiments are based on but not limited to topics covered in 03 CS 6172/6211: Advanced Operating Systems and 03 CS 6182: Modern Computer Networks.

Experiments

Experiment No	Description	Hours Allotted
I	Introduction to Linux-booting-login-simple commands	1
II	Wild card characters- grep- pipe-tee-command substitution-shell variables-subshells- filters head, tail. cut, paste, sort, uniq, nl, join	1
III	Editors-Vi and Emacs	1
IV	Communication commands-mail, talk,write, cron…	1
V	Process related commands-ps, kill, nohup, nice, time, archiving, tar-gzip-rpm	1
VI	Shell Programming Commands -Shell variables, read, echo, command line arguments, &&, !!, if, while, case, for, until, test, set, shift, trap	4
VII	Implement the following: Dining philosopher Problem, Producer Consumer problem, Binary Search Implementation using shell scripting, quick sort implementation using shell scripting, Message queue, Kernel compilation, System call implementation, Scheduling Algorithms.	6
VIII	Develop application using Inter-Process Communication (using shared memory, pipes or message queues).	2
IX	System Administration-Booting, init, runlevels.	1
X	Setting up servers-DHCP, DNS, NFS, Apache, Samba	2
XI	Implement Dijkstra's algorithm to compute the shortest path through a graph.	2
XII	Implement distance vector routing algorithm.	2
XIII	Implement encryption and decryption using DES algorithm.	2
XIV	Implement encryption and decryption using RSA algorithm.	2

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 7113	**Pattern Recognition**	3-0-0	3	2015

Course Objectives

- Introduces the basic mathematical and statistical techniques commonly used in pattern recognition which will help the student to understand, compare and contrast various pattern recognition techniques along with an adequate background on probability theory, statistics, and optimization theory to tackle a wide spectrum of engineering problems.
- Provides variety of pattern recognition algorithms and will give a fair idea about which algorithm works best under what condition and that provide an adequate knowledge on how to solve real world problems using these pattern recognition algorithms.

Syllabus

Perception, Image Processing and Pattern Recognition, Pattern Recognition Systems, Statistical Pattern Recognition: Probability theory, Bayesian Decision Theory. Methods for parameter estimation, parametric techniques for density estimation. Linear discriminant function based classifiers, Sequential Models, Probabilistic Graphical Models and Regression. Feature Extraction and Selection, Dimensionality Reduction, Recent advances in Pattern Recognition.

Expected Outcome

- Introduces the fundamental pattern recognition and machine learning theories.
- Make the students able to design systems and algorithms for pattern recognition with focus on sequences of patterns that are analyzed and analyze classification problems probabilistically and estimate classifier performance.
- Also helps to understand and analyze methods for automatic training of classification systems.

References

1. Pattern Classification, R.O. Duda, P. E.Hart and D.G. Stork, John Wiley, 2001
2. Pattern Recognition, S. Theodoridis and K. Koutroumbas, 4th Ed., Academic Press, 2009
3. Pattern Recognition and Machine Learning, C.M. Bishop, Springer, 2006.
4. Marsland, S. Machine Learning: An Algorithmic Perspective. CRC Press. 2009.
5. Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995.
6. Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning. Springer. 2001.
7. Koller, D. and Friedman, N. Probabilistic Graphical Models. MIT Press. 2009.
8. V. S. Devi, M. N. Murty, "Pattern Recognition: An Introduction", Universities Press, Hyderabad, 2011.
9. Earl Gose, Steve Jost, "Pattern Recognition and Image Analysis", PHI Publishers, 1997.
10. Robert J. Schalkoff, "Pattern Recognition: Statistical Structural and Neural Approaches", John Wiley & Sons Inc., New York, 1992.
11. Tou and Gonzales, "Pattern Recognition Principles", Wesley Publications Company, London 1974.

03 CS 7113 - COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	Introduction: Machine Perception, Image Processing and Pattern Recognition, Pattern Recognition Systems, Design cycle, Learning and Adaptation, Applications of pattern recognition.	4	25
	Statistical Pattern Recognition: Probability theory basics, Probability density function, Normal density, Bivariate and Multivariate density functions.	3	
	Bayesian Decision Theory-Minimum error rate classification, Classifiers, discriminant functions and decision surfaces.	3	
FIRST INTERNAL EXAM			
II	Methods for parameter estimation-Maximum-Likelihood (ML) estimation-Maximum a posteriori (MAP) estimation- Gaussian mixture model (Both unimodal-and multimodal distribution)-Expectation-maximization method	5	25
	Non-parametric techniques for density estimation-Histograms- Kernel Density Estimators- Parzen window method, K-Nearest Neighbour method, Adaptive Decision Boundaries, Adaptive Discriminant Functions, Minimum Squared Error functions.	5	
III	Linear discriminant function based classifiers- Separability, Perceptrons and Support Vector Machines-Minimum Mean Squared Error (MME) method -The Ho-Kashyap method.	5	25
	Probabilistic Graphical Models- Bayesian Networks, Dynamic Bayesian Networks. Sequential Models-Hidden Markov Models. Regression-Linear models for regression-Polynomial regression.	4	
SECOND INTERNAL EXAM			
IV	Feature Extraction and Selection: Entropy minimization, Karhunen Loeve transformation, Feature selection through functions approximation, Binary feature selection.	4	25
	Dimensionality Reduction: Problems of dimensionality, Component analysis and discriminants, Principal Component Analysis, Linear Discriminant Analysis, Fisher discriminant analysis.	5	
	Recent advances in Pattern Recognition: Neural Network structures for Pattern Recognition, Pattern classification using Genetic Algorithms, real life applications	5	
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 7123	**Computational Linguistics**	3-0-0	3	2015

Course Objectives

- To familiarize the fundamentals of speech and written language processing
- To study the applications of these techniques in real world problems like spell-checking, Parts-of Speech Tagging, Corpus development, Word net, speech recognition, pronunciation modelling, dialogue agents, document retrieval etc.
- To gather information about widely used language processing resources

Syllabus

Regular expression & automata, Morphology & finite state transducers, Lexicon-free FSTsg, Probabilistic models of pronunciation & spelling , *N*-grams for Spelling and Pronunciation, Rule-based Part-of-speech Tagging - Stochastic Part-of-speech Tagging - Transformation-Based Tagging, The Earley Algorithm, Probabilistic Context-Free Grammars , Semantic Analysis- Syntax-Driven Semantic Analysis- Attachments for a Fragment of English- Integrating Semantic Analysis into the Earley Parser - Lexical Semantics, Word Net: A Database of Lexical Relations- The Internal Structure of Word- Word Sense Disambiguation and Information Retrieval- Selection Restriction-Based Disambiguation- Robust Word Sense Disambiguation- Information Retrieval, Pragmatics: Discourse - Reference Resolution - Text Coherence- Discourse Structure, Discourse Planning, Applications & Techniques .

Expected Outcome

In depth knowledge in

- Language processing fundamentals like morphology, Syntax, Semantics and pragmatics.
- Application of various computational models in application domains like Machine translation, information retrieval etc

References

1. Daniel Jurafsky and James H. Martin. “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”. 2/e, Prentice Hall, 2008.
2. Christopher D. Manning, Hinrich Schuetze, “Foundations of Statistical Natural Language Processing”, MIT Press, 2003.
3. James Allen, “Natural Language Understanding”, Pearson Education, 2003.

03 CS 7123- COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction, Words – Regular expression & automata, Morphology & finite state transducers –- Finite-State Morphological Parsing - Combining FST Lexicon and Rules - Lexicon-free FSTs: The Porter Stemmer - Human Morphological Processing, Probabilistic models of pronunciation & spelling - Minimum Edit Distance- The Bayesian method for pronunciation -Weighted Automata- The Viterbi Algorithm. N-grams - Simple (Unsmoothed) *N*-grams – Smoothing – Backoff - Deleted Interpolation - *N*-grams for Spelling and Pronunciation.	10	25
FIRST INTERNAL EXAM			
II	Syntax: Word classes & POS tagging- Rule-based Part-of-speech Tagging - Stochastic Part-of-speech Tagging - Transformation-Based Tagging, Context-Free Grammars for English, Parsing with Context-Free Grammars - A Basic Top-down Parser- Problems with the Basic Top-down Parser - The Earley Algorithm, Features and Unification, Lexicalized and Probabilistic Parsing - Probabilistic Context-Free Grammars - Probabilistic Lexicalized CFGs - Dependency Grammars, Language and Complexity - The Chomsky Hierarchy- The Pumping Lemma	10	25
III	Semantics : Representing Meaning- Computational Desiderata for Representations- Meaning Structure of Language - FOPC, Semantic Analysis- Syntax-Driven Semantic Analysis- Attachments for a Fragment of English- Integrating Semantic Analysis into the Earley Parser - Lexical Semantics- Relations Among Lexemes and Their Senses- WordNet: A Database of Lexical Relations- The Internal Structure of Word- Word Sense Disambiguation and Information Retrieval- Selection Restriction-Based Disambiguation- Robust Word Sense Disambiguation- Information Retrieval, Pragmatics: Discourse - Reference Resolution - Text Coherence- Discourse Structure, Generation- introduction-architecture- Surface Realization- Discourse Planning	12	25
SECOND INTERNAL EXAM			
IV	Applications & Techniques : Statistical Alignment & Machine Translation – Text alignment - Word alignment - Statistical Machine Translation, Clustering –Hierarchical & non-Hierarchical clustering, Text categorization – decision trees – maximum entropy modeling – perceptrons - K nearest neighbor classification	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 7013	**Advanced Data Mining Concepts**	3-0-0	3	2015

Course Objectives

- To learn about the general architecture of data mining systems, as well as gain insight into the kinds of data on which mining can be performed the types of patterns that can be found, and how to tell which patterns represent useful knowledge.
- To learn methods for mining the simplest form of frequent patterns and basic techniques for data classification.

Syllabus

Data mining:-Basic Concepts and Functionalities, Classification of Data Mining Systems, Online Analytical Processing, Data Warehousing, Data Preprocessing. Association rule mining: Naïve algorithm, the Apriori algorithm. Classification: Decision tress, Naïve Bayes method. Prediction. Cluster Analysis. Clustering methods. Partitional Algorithm. Divisive and Agglomerative methods. GA based clustering, Large Database. Web Mining.

Expected Outcome

- This course provides a comprehensive understanding of different data mining tasks and the algorithms most appropriate for addressing them.
- Defines knowledge discovery and data mining and helps to recognize the key areas and issues in data mining.
- Gives a fair idea about what type of data are to be mined and present a general classification of tasks and primitives to integrate data mining system.

References

1. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Morgan Kaufmann, 2nd Ed., 2005.
2. G. K. Gupta "Introduction to Data Mining with Case Studies", Eastern Economy Edition, Prentice Hall of India, 2006.
3. Soumen Chakrabarti, "Mining the Web: Discovering Knowledge from Hypertext Data", Morghan Kaufmann, 1st Ed., 2005.
4. Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", Prentice Hall, 1st Ed., 2002.
5. Da Ruan, Guoqing Chen, Etienne E. Kerre, Geert Wets, "Intelligent Data Mining: Techniques and Applications (Studies in Computational Intelligence)", Springer, 1st Ed., 2010.
6. Masoud Mohammadian, "Intelligent Agents for Data Mining and Information Retrieval", Idea Group Publishing, 2004.
7. I. H. Witten and E. Frank. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann, 2000.
8. D. Hand, H. Mannila and P. Smyth. Principles of Data Mining. Prentice-Hall. 2001.

03 CS 7013– COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Data mining:-Basic Concepts and Functionalities, KDD process, Architecture of a typical Data Mining System, Classification of Data Mining Systems, Different kinds of data used for mining, Kinds of Patterns that can be Mined, Major Issues in Data Mining. Data Preprocessing: - Data cleaning, data integration and transformation, data reduction, Discretization and concept hierarchy generation. Data Warehouse: Basic concepts, Differences between Operational Database Systems and Data Warehouses, Stars, Snowflakes, and Fact Constellations: Schemas for Multidimensional Data Models, Typical OLAP Operations.	13	25
FIRST INTERNAL EXAM			
II	Association Rules mining- Introduction, basics, Naïve Algorithm, improved Naïve algorithm, the Apriori algorithm, Frequent, closed and maximal Item set, Mining frequent patterns without candidate generation. Classification and Prediction:-Decision Tree - tree induction algorithm, Split algorithm based on information theory, Split algorithm based on the Gini index- Naïve Bayes method- Estimating predictive accuracy of classification methods.	10	25
III	Cluster Analysis: -Desired features of cluster Analysis, Types of data in cluster analysis, Computing Distance, clustering methods: Partitional methods -MST, Squared Error, K-Means, Nearest Neighbor, PAM, Hierarchical methods-Single link, average Link, Complete Link, Dendrogram - Divisive and Agglomerative methods- GA based clustering, Categorical algorithm, Dealing with Large Databases, Quality and validity of cluster analysis methods .	12	25
SECOND INTERNAL EXAM			
IV	Web Mining:-Introduction, Web data, Web Knowledge mining Taxonomy, Web Content Mining, Web usage Mining, Ontology based web mining research, Web Mining Application.	7	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 7133	**Computational Intelligence**	3-0-0	3	2015

Course Objectives

- To familiarize the salient approaches
- Computational Intelligence
- Fuzzy Logic
- Artificial neural networks
- Genetic algorithms
- Swarm Intelligent Systems
- Hybrid Systems

Syllabus

Introduction to Computational Intelligence; Fuzzy Sets & Logic, Defuzzification methods; Artificial Neural Network, Typical architectures, Different learning methods, Common activation functions, Models Of Neural Network; Genetic Algorithm, Evolutionary Computation, Genetic Programming Schema theorem, Machine Learning; Multi-objective & Multimodal optimization in GA; Applications; Swarm Intelligent Systems; Hybrid Systems.

Expected Outcome

- Understand basic concepts in artificial neural networks, fuzzy logic, and genetic algorithm
- Able to apply Computational Intelligence techniques to research problems.

References

1. A.P. Engelbrecht, Computational Intelligence: An Introduction, 2nd Edition, John Wiley & Sons, 2012.
2. N.P Padthy, Artificial Intelligence and Intelligent System, Oxford Press New Delhi.
3. Hung T. Nguyen, Elbert A. Walker, a First Course in Fuzzy Logic, 2nd Edition.
4. Timothy J. Ross, Fuzzy Logic with Engineering Applications, McGraw Hill, 1997.
5. Yegnanarayanan B, Artificial Neural Networks, PHI.
6. David E Goldbeg, Genetic Algorithms In Search, Optimization And Machine Learning, Pearson Education, 2006
7. Elaine Rich, Kevin Knight- Artificial Intelligence
   Mitchell Melanie, An Introduction To Genetic Algorithm Prentice Hall 1998

03 CS 7133– COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction to Computational Intelligence: Intelligence Machine. Computational intelligence paradigms. Short History. Fuzzy systems: Introduction, Fuzzy versus Crisp, Fuzzy sets-membership functions, Fuzzy Relations, Arithmetic Operations Of Fuzzy Numbers, Linguistic Descriptions, Fuzzy Measures, Defuzzification Methods, Fuzzy Logic In Control And Decision Making Application	10	25
FIRST INTERNAL EXAM			
II	Artificial Neural Networks: Introduction, Artificial Neurons, Activation Functions, Learning Rules, Neural Network Architectures, Supervised Learning Neural Networks: Multi-Layer Feed forward Neural Networks, Simple Recurrent Neural Networks, Time-Delay Neural Networks, and Supervised Learning Algorithms. Unsupervised Learning Neural Networks: Self-Organizing Feature Maps. Radial Basis Function Networks. Deep Neural Networks And Learning Algorithms .Case Studies.	8	25
III	Genetic Algorithms: Introduction, Role of GA In Optimization, Fitness Function, Selection of Initial Population, Cross Over (Different Types), Mutation, Inversion, Deletion, Constraints Handling; Evolutionary Computation; Schema Theorem; Machine Learning Approach To Knowledge Acquisition. Multiobjective & Multimodal Optimization in GA; Applications: Travelling Salesman Problem, Graph Coloring Problem.	12	25
SECOND INTERNAL EXAM			
IV	Swarm Intelligent System: Introduction, Ant Colony systems, Development of Ant Colony System, Working Of Ant Colony System. Applications. Hybrid Systems: GA Based BPNN (Weight Determination, Application); Neuro Fuzzy Systems—Fuzzy BPNN--Fuzzy Neuron, Architecture, Learning, Application; Fuzzy Logic Controlled GA.	12	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 7143	**Machine Learning**	3-0-0	3	2015

Course Objectives

- To understand the different machine learning problems and how to design a learning system
- To impart deeper knowledge of supervised learning, unsupervised and reinforcement learning algorithms
- To understand the concepts of dimensionality reduction, kernel machines and parametric methods and its application in learning problems

Syllabus

Introduction to machine learning- Well Posed learning problems, Supervised Learning, Bayesian Decision theory, Parametric methods, Dimensionality Reduction, Clustering, non-parametric methods, Decision trees, kernel machines, linear discrimination, Bayesian estimation, Hidden Markov model, unsupervised learning, reinforcement learning, design of machine learning experiments, case study.

Expected Outcome

- The ability to analyze the learning problems
- The ability to apply the different machine learning algorithms in the learning problems.

References

1. Ethem Alpaydın, "Introduction to Machine Learning", Second edition, MIT Press, 2010.
2. Tom M Mitchell, "Machine Learning", McGraw-Hill Science.
3. Jerome Friedman, "The Elements of Statistical Learning, Data Mining, Inference, and Prediction", Second Edition, 2009.

03 CS 7143– COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction to machine learning- Well Posed learning problems- Designing a Learning system- Issues in Machine learning, Supervised Learning- VC Dimension – PAC learning- Learning Multiple Classes, Bayesian Decision theory- Classification, Discriminant Functions, Association rules, Parametric methods-Maximum Likelihood Estimation- Baye's Estimator-Parametric Classification, Regression	8	25
FIRST INTERNAL EXAM			
II	Dimensionality Reduction – Subset Selection-Principal Component Analysis-Linear Discriminant Analysis, Clustering- K-means Clustering- Expectation maximization Algorithm- hierarchical Clustering, Non-Parametric methods- Kernel Estimator- K-nearest neighbour estimator, Decision Trees- Univariate Trees-Classification trees, Regression trees, Rules extraction from Trees	12	25
III	Linear Discrimination- Generalizing the Linear Model-Geometry Of linear model, Local models, Kernel Machines- Optimal Separating Hyperplane- Soft margin Hyper plane,-Support Vector Machines- Kernels, One-class and multi-class kernel machines Bayesian Estimation- MAP estimate-Bayesian Classification	13	25
SECOND INTERNAL EXAM			
IV	Concepts of Hidden Markov model, Concepts of Unsupervised and Reinforcement learning, Design and Analysis of machine Learning Experiments, Case Study	9	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 7153	**Embedded Systems Design**	3-0-0	3	2015

Course Objectives

- To understand about embedded system and its components
- To understand the basic principles of RTOS
- To understand the services provided by an embedded system

Syllabus

Introduction to embedded systems,, Embedded Software Development Process, Operating Systems Basic Principles, Introduction to Distributed operating system, Scheduling algorithms and Introduction to RTOS , More operating system services, Memory Management, Interrupt routine in an RTOS environment, VXWORKS, State Transition Diagram, , Context Switches

Expected Outcome

- Ability to design an embedded system
- Ability to distinguish various operating system services
- Ability to distinguish between various process scheduling algorithms
- Ability to distinguish various memory management schemes

References

1. Raj Kamal, Introduction to Embedded Systems, Tata McGraw Hill Publications, 2002.
2. Frank Vahid, Tony D. Givargis, Embedded System Design- A Unified Hardware/ Software Introduction, John Wiley and Sons, Inc 2002.
3. Programming for embedded systems. Dreamtech Software Team, Wiley, 2002.
4 Silberschatz, Galvin, Gagne Operating System Concepts, 6th edition, John Wiley, 2003.
5. Real-Time Concepts for Embedded Systems by Qing Li, Caroline Yao, CMP Books.
6. VxWorks Programmers Guide.

03 CS 7153– COURSE PLAN			
Module	**Contents**	**Hours Allotted**	**% of Marks in End-Semester Examination**
I	Introduction to embedded systems: Classification of embedded systems, overview of embedded system architecture. Hardware architecture, Embedded Software Development Process, Embedded Systems on a Chip (SoC).	11	25
FIRST INTERNAL EXAM			
II	Operating Systems: Basic Principles-Operating System structures – System Calls–Files –Processes –Design and Implementation of processes –Communication between processes –Introduction to Distributed operating system –issues in distributed system : states, events, clocks-Distributed scheduling-Fault &recovery	11	25
III	Scheduling algorithms and Introduction to RTOS: Scheduling algorithms: Round Robin, Preemptive Earliest deadline first. RTOS Architecture, Introduction to RTOS- Task and task states, Task and data, Semaphore and shared data, More operating system services, - Message Queues, Mail boxes and pipes, Timer functions , events, Memory Management, Interrupt routine in an RTOS environment.	10	25
SECOND INTERNAL EXAM			
IV	Case Studies: VXWORKS: Memory Managements Task State Transition Diagram, Pre-Emptive Priority, Scheduling, Context Switches – Semaphore Binary mutex, Counting, I/O System	10	25
END SEMESTER EXAM			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 7903	**Seminar II**	0-0-2	2	2015

Course Objectives

To make students,

- Identify a domain of interest.
- Identify sufficient number of latest good quality research papers on a particular problem or allied problems.
- Do extensive study and analysis of the problem and solution(s).
- Prepare a comprehensive report.
- Make a presentation of 30 minutes based on the problem.

Seminar Guidelines

- Topic should be relevant to the stream of study with content suitable for M.Tech level presentation.
- For selection of topics refer internationally reputed transactions/journals. The primary reference should be published during the last two or three years.
- A detailed write-up /synopsis should be prepared in the prescribed format given by the Department and get the topic approved by the PG Coordinator well in advance.
- The seminar shall be of 30 minutes duration and a committee, with the PG Co-ordinator as the chairman and two faculty members from the department as members shall evaluate the seminar based on the technical content, presentation, depth of knowledge and ability to answer the questions put forward by the committee.
- After the completion of the Seminar work the students would be required to submit two copies of the seminar reports prepared by them in the prescribed format.

Expected Outcome

To student

- Gets good exposure to a domain of interest and the research problems in the domain
- Improves his/her writing and presentation skills
- Gets practice in the art of doing literature survey

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 7913	**Project (Phase I)**	0-0-8	6	2015

Course Objectives

Provides each student the opportunity to conduct an extensive literature survey in the area of specialization to identify a specific domain and a problem in that domain for the project work under the guidance of a faculty advisor. The student is expected to analyze the problem in depth, study the feasibility of the problem, prepare detailed design documentation and identify the methodology for implementation. On completion of this, student is expected to continue with the implementation of the project.

Syllabus

Each student shall identify a project related to the curriculum of study.

Expected Outcome

The student is expected to identify a domain in the area of specialization, do enough exploration by reviewing the literature. The student should also identify his problem and objectives. The progress will be assessed by two reviews. First review would highlight the topic, objectives, methodology and expected results and shall be conducted in first half of the semester. Second review comprises of the presentation of the work completed and scope of the work which is to be completed in the forthcoming semester. Progress of the project work is to be evaluated at the end of the semester. The student is also expected to submit a preliminary report at the end of the semester.

Guidelines for Project Progress Evaluation

- **Total Marks : 50**
- Progress evaluation by the Project Supervisor : 20 Marks
- Presentation and evaluation by the committee : 30 Marks

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03 CS 7914	**Project (Phase II)**	0-0-21	12	2015

Course Objectives

By the first quarter of the semester, the student should compile his/her work by doing the final experimentation and result analysis. Towards the middle of the semester there would be a pre-submission evaluation to assess the quality and quantum of work by the department evaluation committee. The committee can make suggestions/modifications to improve the quality or quantity of the work done. The student has to submit the completed thesis report incorporating all such suggestions/modifications and get approval from the department evaluation committee before final submission. The final evaluation of the thesis would be done by an external examiner.

Syllabus

Each student shall identify a project related to the curriculum of study.

Expected Outcome

The student is expected to publish technical papers related to his/her research in peer reviewed journals/conferences.

Guidelines for Project Progress evaluation

- **Total Marks: 100**
- Project evaluation by the supervisor: 30 Marks
- Evaluation by the External Expert: 30 Marks
- Presentation & Evaluation by the Committee: 40 Marks

SCHEME & SYLLABUS FOR M.TECH (FULL TIME) DEGREE COURSE

in

ELECTRONICS AND COMMUNICATION ENGINEERING(2015 Scheme)
(Specialization: Communication Engineering)
(Faculty of Engineering)
At

PATHANAMTHITTA - ALAPPUZHA CLUSTER

of the

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

M.Tech (Full Time) Degree Course in
ELECTRONICS AND COMMUNICATION ENGINEERING
(Specialization: Communication Engineering)

SCHEME

Credit requirements :- 68 credits
Normal Duration :- Regular: 4 semesters; External Registration: 6 semesters;
Maximum duration :- Regular: 6 semesters; External registration : 7 semesters.
Courses: Core Courses:- Either 4 or 3 credit courses; Elective courses: All of 3 credits

Semester 1 (Credits: 23)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	03EC 6201	Advanced Optical Communication System	4-0-0	40	60	3	4
B	03EC 6211	Advanced Digital Communication Techniques	4-0-0	40	60	3	4
C	03EC 6221	Communication Networks	4-0-0	40	60	3	4
D	03EC 6231	Advanced Signal Processing	3-0-0	40	60	3	3
E		Elective1	3-0-0	40	60	3	3
S	03RM 6001	Research Methodology	1-1-0	100			2
T	03EC 6901	Seminar 1	0-0-2	100			2
U	03EC 6811	Communication Engineering Lab I	0-0-2	100			1

Total 23

Elective 1:-	
03EC 6241	Digital Microwave Communication
03EC 6251	Satellite Communication
03EC 6261	Information Theory

Semester 2 (Credits: 19)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	Duration (hrs)	
A	03EC 6202	Estimation and Detection	4-0-0	40	60	3	4
B	03EC 6212	Wireless Communication	3-0-0	40	60	3	3
C	03EC 6222	Antenna Theory and Design	3-0-0	40	60	3	3

D		Elective-2	3-0-0	40	60	3	3
E		Elective-3	3-0-0	40	60	3	3
V	03EC 6902	Mini Project	0-0-4	100			2
U	03EC 6822	Communication Engineering Lab II	0-0-2	100			1
						Total	19

Elective 2:-	
03EC 6232	Coding Theory
03EC 6242	MIMO Communication Systems
03EC 6252	Secure Communication
Elective 3:-	
03EC 6262	Electromagnetic Interference and Compatibility
03EC 6272	Photonic Switching and Optical Networks
03EC 6282	Adhoc Networks

Semester 3 (Credits: 14)

Exam Slot	**Course No:**	**Name**	**L- T - P**	**Internal Marks**	**End Semester Exam**		**Credits**
					Marks	Duration (hrs)	
A		Elective-4	3-0-0	40	60	3	3
B		Elective-5	3-0-0	40	60	3	3
	03EC 7903	Seminar II	0-0-2	100	0	0	2
	03EC 7913	Project (Phase 1)	0-0-8	50	0	0	6
						Total	14

Elective 4:-	
03EC 7203	High Frequency Circuit Design
03EC 7213	Communication Switching and Multiplexing
03EC 7223	Wireless Systems and Standards

Elective 5:-	
03EC 7233	Embedded Communication Systems
03EC 7243	Modeling and Simulation of Communication Systems
03EC 7253	Signal Compression Theory and Methods

Semester 4 (Credits: 12)

Exam Slot	**Course No:**	**Name**	**L- T - P**	**Internal Marks**	**End Semester Exam**		**Credits**
					Marks	Duration (hrs)	
	03EC 7914	Project (Phase 2)	0-0-21	70	30		12
						Total	12

SEMESTER I

Course No.	Course Name	L -T-P-Credits	Year of Introduction
03EC 6201	ADVANCED OPTICAL COMUNICATION SYSTEMS	4-0-0-4	2015

Syllabus: Rare earth doped fiber, Theory and operation of LASER fiber devices, Optical Amplifiers, Light wave systems, Dispersion Management, Multichannel systems, Soliton systems, Fiber grating filters, Active optical components, Fiber Nonlinearities

References

1. Govind P Agarwal, "Fiber Optic Communication Systems", Wiley India, 2009.
2. Gerd Keiser, "Optical fibre communications", TMH, 4th Edition, 2008.
3. Rajappa Pappannareddy, "Introduction to Light wave Communication System", Arctech House, 2009.
4. Rajiv Ramaswami, Kummar Sivaranjan, "Optical Networks", Morgan Kaufman, 2009
5. B. E. A Saleh, M. C Teich, "Fundamentals of Photonics", Wiley Inter science, 1991

Course Plan

Module	content	Hours	Semester Exam Marks
I	Rare earth doped fiber fabrication techniques and physical properties, Theory and operation of LASER fiber devices, Neodymium and Erbium doped fiber LASERs, Broadband operation, Narrow line width and tunable fiber LASERs, Q switched fiber LASERs, Mode locked fiber LASERs, Rare earth doped fluoride glass fibers, Erbium doped fiber amplifiers, Semiconductor Amplifiers, Semiconductor Optical Amplifiers, types, Raman Amplifiers.	16	25%
II	Light wave systems: System Architecture, Design guidelines, Long haul systems, computer aided design. Dispersion Managements: Need for Dispersion Management, Pre-compensation schemes, Post-compensation schemes, Dispersion compensating fibers, Optical filters, Long haul light wave systems, High capacity systems.	16	25%
First Internal Exam			

III	Multichannel systems: WDM Light wave Systems, WDM components, System Performance issues, Time-Division Multiplexing, Subcarrier Multiplexing, Solitons – concept, Soliton-Based Communications, Los-Managed Solitons, Dispersion Managed Soliton, Impact of Amplifier Noise.	**15**	**25%**
IV	Fiber grating filters – basics, FBG analysis and applications. Dielectric thin film filters, phased- array based devices, diffraction gratings. Isolators and circulators. Active optical components – MEMs, variable optical attenuators, tunable optical filters, dynamic gain equalizers, optical add/drop multiplexers, polarization and dispersion controllers. Self-phase modulation, cross phase modulation, four wave mixing, FWM mitigation, wave length convertors.	**15**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC 6211	**ADVANCED DIGITAL COMMUNICATION TECHNIQUES**	**4-0-0-4**	**2015**

Syllabus: Random Variables: Probability distribution functions - probability density functions-. Characterization of Communication Signals and Systems- Optimum Receivers for AWGN Channels- comparison of digital signaling methods- Synchronization in Communication Systems- Carrier Recovery and Symbol Synchronization in Signal Demodulation- Pulse Shaping and Equalization

References

1.John G. Proakis and Masoud Salehi, "Digital communications", 5th Edition, Tata McGraw Hill, 2008.

2.Ian A. Glover and Peter M. Grant, "Digital Communications", 2nd Edition, Pearson Education, 2008.

3.Bernard Sklar, "Digital Communications: Fundamentals and Applications", 2nd Edition, Pearson Education, 2002.

4.Marvin K.Simon, M. Hinedi and William C. Lindsey, "Digital Communication Techniques: Signal Design and Detection", Prentice Hall of India, 2009.

5.John R. Barry, Edward A. Lee, David G. Messerschmitt, "Digital Communication", Kluwer Academic Publishers, 2004.

Course Plan

Module	content	Hours	Semester Exam Marks
I	Random Variables: Probability distribution function - probability density function - conditional probability - statistical independence, Moment generating function, Central limit Theorem, , Binomial, Gaussian, Chi square, Rayleigh, Rician, Nakagami and Multi variate Gaussian distributions. Characterization of Communication Signals and Systems- Signal space representation, Representation of digitally modulated signals, Memory less modulation methods, Multi dimensional signaling	**16**	**25%**
II	Waveform and Vector Channel Models: Detection of signals in Gaussian noise - optimum detection and error probability for band limited signaling and power limited signaling - non coherent detection - comparison of digital signaling methods -lattices and constellations based on lattices - detection of signaling schemes with memory - optimum receiver for CPM - performance analysis for wireline and radio communication systems;	**16**	**25%**

First Internal Exam			
III	Carrier Recovery and Symbol Synchronization in Signal Demodulation- Signal parameter estimation, Carrier Phase Estimation-, Maximum Likelihood phase estimation, Phase locked loop, Effect of additive noise on the phase estimate; Symbol Timing Estimation- Maximum Likelihood timing estimation- Receiver structure with phase and timing recovery; Joint Estimation of Carrier phase and Symbol Timing.	**15**	**25%**
IV	Pulse Shaping: Characterization of band limited channels - ISI - Nyquist criterion - controlled ISI - channels with ISI and AWGN - pulse shaping for optimum transmissions and reception; Equalization: MLSE - linear equalization - decision feedback equalization - ML detectors - iterative equalization - turbo equalization - adaptive linear equalizer - adaptive decision feedback equalization - blind equalization.	**15**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L -T-P-Credits	Year of Introduction
03EC 6221	COMMUNICATION NETWORKS	4-0-0-4	2015

Syllabus: Network architecture, Multiple access protocols, Reliable Transmission, Internet Architecture - Layering in the Internet, Routing algorithms, Wireless links and Network characteristics, Mobility management, Multimedia networking, Scheduling and policing, QOS, ATM, BISDN, Optical networks, WDM System

References

1. James. F. Kurose and Keith. W. Ross, "Computer Networks: A top-down approach featuring the Internet", Pearson Education, 6/E, 2012.
2. Behrouz Forouzan, "Data Communications & Networking", Tata McGraw-Hill, 2006.
3. Jean Walrand & Pravin Varaiya, "High Performance Communication Networks", Morgan Kaufman Publishers, 2nd edition, 2000.

Course Plan

Module	content	Hours	Semester Exam Marks
I	Introduction to network architecture; Layering and protocols, OSI/Internet architecture, Performance parameters, Data link layer - Error detection and correction, multiple access protocols, Link layer addressing, Ethernet, CSMA/CD, Reliable Transmission-ARQ schemes and analysis.	14	25%
II	Internet Architecture: Layering in the Internet, Applications layer - HTTP, SMTP, Telnet, FTP; TCP/IP protocol stack. Transport layer -TCP and UDP-Congestion control and avoidance, Fairness; Network layer – IPV4 and IPV6, Routing algorithms-Link state, Distance vector, Hierarchical; Routing in the Internet.	16	25%
	First Internal Exam		
III	Wireless links and Network characteristics, IEEE 802.11 wireless LANs-architecture, protocol, framing-Mobility management principles- Mobile IP; Multimedia networking- streaming stored audio and video, protocols for real time interactive applications, Scheduling and policing; QOS- Integrated and Differentiated services.	14	25%

IV	ATM network, features, addressing, signaling, routing, ATM header structure. ATM adaptation layer (AAL), management and control, BISDN, internetworking with ATM. Optical networks, WDM system	**15**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L -T-P-Credits	Year of Introduction
03EC 6231	ADVANCED SIGNAL PROCESSING	3-0-0-3	2015

Syllabus: Discrete-time Signals and Systems, Fast Fourier transform,Multi Rate and Multi-Dimensional Signal Processing, Multidimensional sampling, : Adaptive Signal Processing, LMS adaptive algorithm, Digital Signal Processors, TMS320C5X processor.

References

1.Sanjit K Mitra "Digital Signal Processing" Tata McGraw-Hill Third Edition,2009.
2.Alan V Oppenheim, Ronald W Schafer "Digital Signal Processing" PHI, 2000.
3.Dan E. Dudgeson and Russel M Mersereau,"Multidimensional Digital Signal Processing" , Prentice Hall,1983.
4.Bernard Widrow & Samuel D. Streams, "Adaptive Signal Processing",Prentice Hall,1985
5.B Venkataramani, M Bhaskar , "Digital Signal Processors", Tata McGraw Hill, 2006.

Course Plan

Module	content	Hours	Semester Exam Marks
I	Discrete-time Signals and Sequences, Stability and Causality, Frequency domain representation of discrete-time signals and systems, Sampling of continuous time signals. Z-transform, Stability and ROC, Inverse z-transform, Discrete Fourier transform, Time domain aliasing, Properties of DFT, Fast Fourier transform, IDFT using FFT algorithm, Design of IIR low pass and High pass Digital filters.	14	25%
II	Upsampling and down sampling, Time domain andfrequency domain analysis, identities for mult irate operations, Interpolator and decimator design, Rate conversion, 2D Signals and Systems, Multidimensional sampling, Difference equations, Convolution, Fourier representation, Multidimensional FFT, Z -Transforms, Introduction to multidimensional digital filters.	16	25%
First Internal Exam			

III	Adaptive systems, Definition and characteristics, General properties, open and closed loop adaptation, Performance function and performance surface, Gradient and minimum MSE, Methods of searching the performance surface, Simple gradient search algorithm, Gradient search by method of steepest descent, The LMS adaptive algorithm.	**14**	**25%**
IV	Multiplier and Multiplier Accumulator, Modified bus structure and Memory access scheme in P- DSPs, Multiple access memory, Multiported memory, VLIW architecture, Instruction pipelining, Architecture and Assembly language instructions of TMS320C5X processor.	**15**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC 6241	DIGITAL MICROWAVE COMMUNICATION	3-0-0-3	2015

Syllabus: Overview of Digital Transmission Systems- Basics of Microwave Communication. Introduction to transmission lines - Digital Microwave Communication Systems - Transmitter receiver subsystems - Synchronization on Passband digital transmission - Waveguide components and accessories

References

1.P V. Sreekanth, "Digital Microwave Communication Systems with selected topics in Mobile Communications," Universities Press (India) Pvt. Ltd, 2009.
2.Harvey Lahpamer, "Microwave Transmission Networks: Planning, design, and development," 2nd Edn, Tata McGraw-Hill, 2010.
3.R.Ludwig, P. Bretchko, "RF Circuit Design", Pearson Asia Education, New Delhi, 2004.
4.Richard C, Kirby, FerdoIvanek, "Terrestrial Digital Microwave Communication", Artech House Publishers,1989

Course Plan

Module	content	Hours	Semester Exam Marks
I	Introduction: - Overview of Digital Transmission Systems, Pulse - code modulation, Channel noise and error probability, Quantization noise and signal to noise ratio,Hierarchy of digital transmission systems, Hierarchy of digital modulationtechniques- FSK,PSK, DPSK MSK,QPSK, and QAM.	14	25%
II	Basics of MicrowaveCommunication: - Radio fundamentals, structure and characteristics of earth's atmosphere, Radio propagation, Digital Microwave point-point systems. Introduction to transmission lines: - Review of basic transmission line theory, transmission lines analysis, transmission lines, circuit representations, parameters, transmission line equations, microstrip transmission line terminated lossless transmission line, special termination condition, sourced and loaded transmission lines,	16	25%

First Internal Exam			
III	Digital Microwave Communication Systems: 34 and 2Mb traffic, arrangement ofModules, signal flow in 34+2Mb equipment, Transmitter receiver subsystems, andvarious data rates in 34+2Mb digital MW radio.Data frame structure of 30 Channel primary MUX, Signaling in communication, R2signaling, and description of 2/34 MUX equipment.	**14**	**25%**
IV	Synchronization on Passband digital transmission: - Synchronization concept, carrier synchronization, symbol synchronization, carrier and symbol synchronization in DMR 770.Waveguide components and accessories – bands, corners, taper, twist, flexible wave guide, loading elements, ferrite devices. Accessories – clamps, earthingpit, flanges and coupling, bending tools, Precautions while hoisting waveguide	**15**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC 6251	**SATELLITE COMMUNICATION**	3-0-0-3	**2015**

Syllabus: Mobile Satellite System, Satellite Constellations, Radio Link, Noises in Satellite Communications, Modulation, Coding, Multiple Access and user terminals, Coding, Multiple Access Schemes, User Terminals, Satellites for MSS, Radio Resource Management, Satellite Antennas, Mobile Satellite Broadcast Systems, The Future Techniques, Little-LEO Systems

References

1. Madhavendra Richharia "Mobile Satellite Communications: Principles and Trends", 2nd Edition, Wiley 2014
2. Kenneth Y. Jo "Satellite Communications Network Design and Analysis"- Artech House Publishers, 2011

Course Plan

Module	Content	Hours	Semester Exam Marks
I	Mobile Satellite System Architecture, Satellite Constellations, Considerations in Constellation Design, Polar Constellations Inclined Orbit Constellations, Hybrid Constellations Regional Coverage, Constellations for Non-Real-Time Systems, Use of Spot Beams, Availability Considerations for Non-Geostationary Satellites, Radio Link: Spectrum Issues, Radio Frequency (RF) Links and Bandwidth in Satellite Communications. End-to-End Analysis of Combined Uplink and Downlink, Noises in Satellite Communications. Effect of Environmental Factors on Link Performance	**16**	**25%**
II	Modulation, Coding, Multiple Access and user terminals:- Modulation, PSK Schemes, Performance Comparison of Conventional Digital Modulation Schemes, Coded Orthogonal Frequency Division Multiplexing (COFDM)Modulation Systems, Spread Spectrum Modulation, Coding:- Trellis-Coded Modulation (TCM), Modulation and Coding Trends and Issues, Automatic Repeat Request, Multiple Access Schemes:- Comparison of Multiple Access Schemes, Comparison of Spectral and Power Efficiency, User Terminals:- Antennas, Hand-Held UT, Mobile Terminals	**16**	**25%**

First Internal Exam			
III	Satellites for MSS, Intersatellite links, Launching Satellite Constellations, Radio Resource Management-Spectrum Management, EIRP Management, Satellite Antenna Characteristics – Antenna Footprints. Spot Beam Contour as the Intersection of Cone and Sphere. Parabolic Satellite Antenna. Multibeam Antennas. Phased Array Antennas.	**15**	**25%**
IV	Mobile Satellite Broadcast Systems:- System Requirements, System Configuration, Space Segment, Transmission Technology, The Future Techniques:- Capacity Enhancement Techniques, System Architecture, Enabling Concepts and Technologies, Little-LEO Systems, Mobile Satellite Systems in Future Networks.	**15**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC 6261	**INFORMATION THEORY**	3-0-0-3	**2015**

Syllabus: - Entropy ,Mutual Information and conditional mutual information, Lossless source coding, Channel Capacity, Differential Entropy, Rate Distortion Theory

References

1.Thomas M. Cover and Joy A. Thomas, "Elements of Information Theory", John Wiley & Sons 2006.
2.Robert Gallager, "Information Theory and Reliable Communication", John Wiley &Sons, 1968
3.R. J. McEliece, "The theory of information & coding", Addison Wesley Publishing Co., 1977.
4.T. Bergu, "Rate Distortion Theory, A Mathematical Basis for Data Compression" PH Inc. 1971.
5.TriT.Ha "Theory and Design of Digital Communication systems", Cambridge University Press, 2011

Course Plan

Module	Content	Hours	Semester Exam Marks
I	Entropy- Memory less sources- Markov sources- Entropy of a discrete Random variable- Joint, conditional and relative entropy- Mutual Information and conditional mutual information- Chain relation for entropy, relative entropy and mutual Information	**16**	**25%**
II	Optimal codes- Huffman code- Optimality of Huffman Codes-Lempel Ziv Codes- Arithmetic Coding- Shannon's Source Coding Theorem. Source Coding theorem Efficient Source Coding, Shannon-McMillan-Bramman Theorem	**16**	**25%**
First Internal Exam			
III	Channel Capacity- Capacity computation for some simple channels- Arimoto-Blahut algorithm- Fano's inequality- Shannon's Channel Coding Theorem and its converse- Channels with feedback- Joint source channel coding Theorem. Continuous Sources and Channels	**15**	**25%**

IV	Differential Entropy- Joint, relative and conditional differential entropy-Mutual information- Waveform channels- Gaussian channels- Mutual information and Capacity calculation for Band limited Gaussian channels- Shannon limit- Parallel Gaussian Channels-Capacity of channels with colored Gaussian noise-Water filling. Rate Distortion Theory Introduction - Rate Distortion Function - Properties - Continuous Sources and Rate Distortion measure - Rate Distortion Theorem - Converse - Information Transmission Theorem - Rate Distortion Optimization.	**15**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P	Credits	Year of Introduction
03RM6001	Research methodology	1-1-0	2	2015

Course Objectives:

- This course is designed to familiarize the student with the research process, problem identification strategies and formulation of a research plan by doing case studies

Syllabus

Introduction to Research Methodologies - Objectives -motivation in research- Significance of research - interaction between industries and research units –research and innovation

Research Formulation- - literature review–

Ethics in research: – copy right – plagiarism – citation – acknowledgement

Research Design – and Report writing

Case Studies : Department / stream specific case study and preparation of a research plan or a review paper

Expected Outcomes:

- Students will be able to write a review paper after critically evaluating the state of the art development in a topic of interest
- Students will acquire capability to write a research proposal in the form of a technical paper which could lead the student towards his / her final thesis topic
- **No formal end semester examination is intended – Evaluation is based on internal oral presentations and a Technical Report or a Research Plan or a Review Paper**

References

1. R. Paneersalvam, "Research Methodology",Prentice Hall of India Pvt. Ltd.,2011
2. Mike Martin, Roland Schinzinger, "Ethics in Engineering" ,McGraw Hill Education, Fourth Edition,.2014
3. Vinod V Sople," Managing Intellectual Property-The Strategic Imperative, EDA", Prentice of Hall Pvt. Ltd.,2014
4. Kothari C R &Gaurav Garg – "Research Methodology- Methods and Techniques",New Age International(P) Ltd Publications,2006
5. Day A Robert,"How to write and publish a scientific paper",Cambridge University,UK,2012
6. Leedy P D,"Practical Research-Planning and Design", Prentice Hall of India Pvt. Ltd.

COURSE PLAN

Module	Contents	Hours Allotted	% of Marks in End-Semester Examination
I	**Introduction** –Need for research- objectives and motivations in research- Significance of research - -need for interaction between academic institutions, industrial and research establishments – research and innovation. Research Formulation- Identifying a research problem- - literature review– **confirming to a research problem based on literature review.**	**4**	**25%**
FIRST INTERNAL EXAM			
II	Research Ethics – Environmental impacts – Ethical issues - Intellectual Property Rights – Patents – legal formalities in filing patent in India – Copy right– plagiarism – citation and acknowledgement.	3	25%
III	**Research design** –Prepare research plan. **Report writing** – types of report – research report, research proposal, funding agencies for research concerned to the specialization, significance of peer reviewed articles and technical paper- - simple exercises - oral presentation	3	
SECOND INTERNAL EXAM			
IV	**Case Studies** The student is expected to **prepare a research plan** relating to a topic of current interest in the concerned specialization, which has appeared in a recent journal. A minimum of 20 related referred articles should be critically studied. On the basis of this, the student is expected to prepare a review report/paper of publishable quality.	6	50%

	This paper has to be presented for open defence before the departmental committee. (This would carry 50% marks)		
END SEMESTER EXAM			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC 6901	SEMINAR	0-0-2-2	2015

Each student shall present a seminar on any topic of interest related to the core/elective courses of the M. Tech. Programme. He / She shall select the topic based on the references from recently published international journals of repute, preferably IEEE/ACM/Springer journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester. Marks will be awarded based on the topic, presentation, participation in the seminar and the report submitted.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC 6811	COMMUNICATION ENGINEERING LAB I	0-0-2-1	2015

All the students are expected to do laboratory experiments based on a minimum three courses that they have undergone in that semester. The PG course coordinator, in consultation with the faculty who are offering the various subjects, and the faculty incharge of the PG laboratory should frame syllabus covering fundamental concepts, design, and implementation of simple applications based on the theory papers the students have undergone during the semester.

Tools: MATLAB, AWR or equivalent tools and other simulation tools

Experiments:

1. Analysis of different distributions:- Uniform, Poisson, Exponential, Gaussian, Rayleigh, Rician, Chi square.
2. Implementation of various digital modulation schemes, constellation diagram, BER analysis (BPSK,BFSK,QAM,M-ary modulation-QPSK,8-PSK)
3. Simulation and analysis of linear block codes
4. Simulation and analysis Convolution codes
5. Spectral analysis of speech signal
6. MFCC of a Speech signal
7. Familiarization of DFT,DCT and DWT of an image and comparison
8. Basic processes of an image- Bit plane slicing, edge detection, noise removal
9. Familiarization of Antenna design software: Basic antenna design and analysis
10. Micro strip antenna design and analysis
11. Performance evaluation of simulated CDMA System.
12. Use of Network Analyser for measurement of transmission line parameters, S- Parameter estimation of Microwave devices etc

SEMESTER II

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC6202:	**ESTIMATION AND DETECTION**	**4-0-0-4**	**2015**

Syllabus:

Fundamentals of detection theory, Hypothesis testing, Composite Hypothesis testing, Fundamentals of Estimation theory, MVU estimator, CRLB, Estimation techniques, Deterministic parameter estimation, BLUE, MMSE.

References

1.M D Srinath, P K Rajasekaran, R Viswanathan, Introduction to Statistical Signal Processing with Applications, “Pearson”, 1995

2.Steven M. Kay, “Statistical Signal Processing: Vol. 1: Estimation Theory, Vol. 2:Detection Theory," Prentice Hall Inc., 1998.

3.Jerry M. Mendel, “Lessons in Estimation Theory for Signal Processing,Communication and Control," Prentice Hall Inc., 1995

4.Ralph D. Hippenstiel, “Detection Theory- Applications and Digital Signal Processing”, CRC Press, 2002.

5.Bernard C. Levy, “Principles of Signal Detection and Parameter Estimation”,Springer, New York, 2008.

6.Harry L. Van Trees, “Detection, Estimation and Modulation Theory, Part 1 and 2," John Wiley & Sons Inc. 1968.

7.Neel A. Macmillan and C. Douglas Creelman, “Detection Theory: A User's Guide (Sec. Edn.)” Lawrence Erlbaum Associates Publishers, USA, 2004.

8.Monson H. Hayes, “Statistical Digital Signal Processing and Modelling," JohnWiley & Sons Inc., 1996.

9.J. M. Wozencraft, I. M. Jacobs,"Principles of Communication Engineering",John Wiley, 1966

10.U. Madhow, "Fundamentals of Digital Communication," Cambridge University Press, 2008.

Course Plan

Module	content	Hours	Semester Exam Marks
I	**Fundamentals of Detection Theory Hypothesis Testing**: Bayes' Detection, MAP Detection, ML Detection, Minimum Probability of Error Criterion, Min-Max Criterion, Neyman - Pearson Criterion, Multiple Hypothesis, Composite Hypothesis Testing: Generalized likelihood ratio test (GLRT), Receiver Operating Characteristic Curves	**12**	**25%**
II	**Fundamentals of Estimation Theory** :Role of Estimation in Signal Processing, Unbiased Estimation, Minimum variance unbiased(MVU) estimators, Finding MVU Estimators, Cramer- Rao Lower Bound, Linear Modeling-Examples, Sufficient Statistics, Use of Sufficient Statistics to find the MVU Estimator	**16**	**25%**
First Internal Exam			
III	**Estimation Techniques Deterministic Parameter Estimation**: Least Squares Estimation-BatchProcessing, Recursive Least Squares Estimation, Best Linear Unbiased Estimation, Likelihood and Maximum Likelihood Estimation	**18**	**25%**
IV	**Estimation Techniques (contd)** Random Parameter Estimation: Bayesian Philosophy, Selection of a Prior PDF, Bayesian linear model, Minimum Mean Square Error Estimator, Maximum a Posteriori Estimation.	**16**	**25%**

Second Internal Exam

End semester Exam

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC6212	**WIRELESS COMMUNICATION**	**3-0-0-3**	**2015**

Syllabus

Mobile radio propagation, fading, diversity, combining methods, performance of digital modulation over wireless channels, capacity of wireless channels, cellular communication, spread spectrum and CDMA system, GSM, OFDM, MIMO, LTE and 4G systems.

References

1.T.S. Rappaport, "Wireless Communication, Principles & Practice", Pearson Education, 2010.

2.Andrea Goldsmith, "Wireless Communications", Cambridge University press, 2008.

3.A.M. Molisch, " Wireless Communications", Wiley India, 2010.

4.G.L Stuber, "Principles of Mobile Communications", 2nd Edn, Kluwer Academic Publishers, 2002.

5.R.L Peterson, R.E. Ziemer and David E. Borth, "Introduction to Spread Spectrum Communication", Pearson Education, 2009.

Course Plan

Module	content	Hours	Semester Exam Marks

I	Mobile Radio Propagation: Large-Scale Path Loss,Small-Scale Fading and Multipath. **Diversity-** Time diversity, Frequency and Space diversity, Receive diversity, Concept of diversity branches and signal paths, Performance gains, **Combining methods**- Selective combining, Maximal ratio combining, Equal gain combining, Transmit Diversity - Alamouti Scheme.	**15**	**25%**
II	**Performance of digital modulation over wireless channels**- AWGN Channels, Fading channels, Doppler spread, Inter symbol interference. Capacity of Wireless Channels, Capacity in AWGN, Capacity of flat fading and frequency selective fading channels	**18**	**25%**
First Internal Exam			
III	**Cellular Communication**: Cellular Networks, Multiple Access: FDM/TDM/FDMA/TDMA, Spatial reuse, Co-channel interference analysis- Hand-off, Erlang Capacity Analysis- Spectral efficiency and Grade of Service, Improving capacity - Cell splitting and sectorization. **Spread spectrum and CDMA systems:** Direct sequence and frequency hopped systems, spreading codes, code synchronization, Capacity of cellular CDMA networks.	**15**	**25%**
IV	**GSM** : GSM sevices and features, GSM system and Architecture, GSM radio subsystem, GSM channel types, Frame structure for GSM, GSM Signal Processing. Overview of: IS-95 standards, 3G systems: UMTS & CDMA 2000 standards and specifications, OFDM system, MIMO, LTE & 4G proposals.	**12**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P-Credits	Year of Introduction

03EC6222:	ANTENNA THEORY AND DESIGN	3-0-0-3	2015

Syllabus

Fundamental concepts and radiation from wires and loops,radiation pattern,Infinitesimal dipole,finite length dipole,Aperture , horn and reflector anteenas,Fourier transform methods in aperture antenna theory,broadband and microstrip antennas, antenna arrays and synthesis,basic concepts and benefits if smart antennas.

References

1.C. A. Balanis, "Antenna Theory Analysis and Design", 3rd Ed., John Wiley & Sons, 2008.

2.W. L. Stutzman, and G. A. Thiele, "Antenna Theory and Design", 2nd Ed., John Wiley & Sons, 2010.

3.F. B. Gross, "Smart Antennas for Wireless Communications", McGraw-Hill, 2005.

4.R. S. Elliot, "Antenna Theory and Design", Revised edition, Wiley-IEEE Press, 2005.

Course Plan

Module	content	Hours	Semester Exam Marks
I	**Fundamental Concepts and Radiation from Wires & Loops.** Physical concept of radiation, Radiation pattern, near- and far-field regions, reciprocity, directivity & gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions, Infinitesimal dipole,finite-length dipole, linear elements near conductors, dipoles for mobile communication-smallcircular loop.	15	25%
II	**Aperture, Horn and Reflector Antennas** Huygens ‘ Principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Fourier transform method in aperture antenna theory, Radiation from sectoral and pyramidal horns, Reflector antennas -design concepts parabolic reflector and cassegrain antennas.	14	25%

First Internal Exam			
III	**Broadband and Microstrip Antennas** Broadband concept, Log-periodic antennas, frequency independent antennas, helical antennas, Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas, micro strip arrays.	**14**	**25%**
IV	**Antenna Arrays and Synthesis** Linear arrays, Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension of planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Fourier transform method, Woodward-Lawson method and Taylor method. Basic Concepts and benefits of smart antennas, fixed weight beam forming basics, Adaptive beamforming-Least Mean square, sample matrix inversion & recursive least squares.	**17**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC6232	**CODING THEORY**	**3-0-0-3**	**2015**

Syllabus

Finite Field Arithmetic, Computations using Galois Field arithmetic- sub fields- Minimal polynomial and conjugates- Vector space- Vector Subspace- Linear independence. Linear Block Codes: Cyclic Codes, The Berlekamp- Massey decoding algorithm. Reed Solomon codes- Generalized Reed Solomon codes- MDS codes. Convolutional Codes, The Viterbi Algorithm- Free distance- Catastrophic encoders.

References

1.Shu Lin and Daniel. J. Costello Jr., "Error Control Coding: Fundamentals and applications", Second Edition Prentice Hall Inc, 2004.
2.Neubauer, J. Freudenberger, V. Kuhn, "Coding Theory, - Algorithms, architectures and applications, Wiley India edition, 2012.
3.Robert H, Morelos-Zaragoza" The Art of Error Correcting Coding", Wiley India Edition, 2013.
4.W.C. Huffman and Vera Pless, "Fundamentals of Error correcting codes", Cambridge University Press, 2003.
5.Robert McEliece "The theory of Information and Coding", Cambridge University Press, 2002

Course Plan

Module	content	Hours	Semester Exam Marks
I	**Finite Field Arithmetic :** Introduction, Groups- Rings- Fields-Arithmetic of Galois Field- Integer Ring- Polynomial Rings- Polynomials and Euclidean algorithm, primitive elements, Construction and basic properties of Finite Fields- Computations using Galois Field arithmetic- sub fields- Minimal polynomial and conjugates- Vector space- Vector Subspace- Linear independence.	**15**	**25%**

II	**Linear Block Codes:** Linear Block codes- Properties- Minimum Distance- Error detection and correction- Standard Array and Syndrome decoding- Hamming codes- Perfect and Quasi-perfectcodes- Extended codes- Hadamard codes.	**15**	**25%**
First Internal Exam			
III	**Cyclic Codes:** Basic theory of Cyclic codes- Generator and Parity check matrices - Cyclic encoders- Error detection & correction- decoding of cyclic codes- BCH codes- Decoding of BCH codes-The Berlekamp- Massey decoding algorithm. Reed Solomon codes- Generalized Reed Solomon codes- MDS codes.	**16**	**25%**
IV	**Convolutional Codes:** Generator matrices and encoding- state, tree and trellis diagram- Transfer function -- Maximum Likelihood decoding Hard versus Soft decision decoding- The Viterbi Algorithm- Free distance- Catastrophic encoders.	**16**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC6242:	**MIMO COMMUNICATION SYSTEMS**	**3-0-0-3**	**2015**

Syllabus

Need for MIMO systems, multiple antennas in wireless communication systems, MIMO Channel models Capacity and Information rates in MIMO channels, Constrained signaling for MIMO communication, Space-Time Block Codes, Space Time Trellis Codes: General space time trellis codes, Basic space-Time code design principles, performance analysis for Space Time trellis codes. MIMO Channel models, Antenna selection for MIMO system.

References

1.Tolga M. Duman, Ali Ghrayeb, Coding for MIMO communication systems - Wiley,2007

2.Howard Huang, Constantinos B. Papadias, SivaramaVenkatesan, MIMO Communication for Cellular Networks – Springer,2011

Course Plan

Module	content	Hours	Semester Exam Marks
I	Need for MIMO systems, multiple antennas in wireless communication systems, MIMO Channel models Capacity and Information rates in MIMO channels: Capacity and Information rates in AWGN and fading channels, Capacity of MIMO channels. Capacity of MIMO channel: Deterministic MIMO channels, Ergodic MIMO channels, Non-Ergodic MIMO channels and outage capacity, transmit CSI for MIMO fading channels. Constrained signaling for MIMO communication	**16**	**25%**

II	Space-Time Block Codes**:** Transmit Diversity with Two Antennas: The Alamouti Scheme Transmission Scheme, Optimal Receiver for the Alamouti Scheme, Performance Analysis of the Alamouti Scheme, Orthogonal Space-Time Block Codes, And Linear Orthogonal Designs. Decoding of Linear Orthogonal Designs Performance Analysis of Space-Time Block Codes, Quasi-Orthogonal Space-Time Block Codes, Linear Dispersion Codes. Space Time Trellis Codes: General space time trellis codes, Basic space-Time code design principles, performance analysis for Space Time trellis codes.	**16**	**25%**
First Internal Exam			
III	MIMO Channel models, Single user MIMO Capacity, Single user capacity metrics, Multi-usercapacity metrics, and Transceivertechniques: Linear receivers, MMSE-SIC, V-BLAST, D- BLAST, and Closed loop MIMO, Space time coding, Code book pre-coding.	**15**	**25%**
IV	Antenna selection for MIMO system: Capacity based Antenna selection, system model, optimal selection, simplified selection, Energy based antenna selection, Antenna selection for space time trellis codes, quasi static fading channel, block fading channel, fast fading channels, Antenna selection for space time block codes, receive antenna selection, transmit antenna selection, antenna selection for frequency selective channels.	**15**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P-Credits	Year of Introduction

03EC6252	SECURE COMMUNICATION	3-0-0-3	2015

Syllabus

Introduction to Finite fields , Basic encryption techniques, Private key and Public key cryptosystems , Elliptic curves .

References

1.Douglas A. Stinson, "Cryptography, Theory and Practice", 2nd edition, Chapman & Hall, CRC Press Company, Washington ,2007

2.William Stallings, " Cryptography and Network Security", 5th edition, Pearson Education,2013

3.Lawrence C. Washington, " Elliptic Curves", Chapman & Hall, CRC Press,2008

Course Plan

Module	content	Hours	Semester Exam Marks
I	**Introduction to Finite fields** : Groups Rings and Fields, Divisibility and the Division Algorithm, Euclidean algorithm- Fermat's and Euler's theorem - Chinese Remainder Theorem -Primality.-Discrete logarithms	12	25%
II	**Basic encryption techniques**- Concept of cryptanalysis, Shannon's theory.Perfect secrecy,Block ciphers, Cryptographic algorithms, Features of DES, Stream ciphers, Pseudo random sequence generators, linear complexity. Non-linear combination of LFSRs.	17	25%
First Internal Exam			

III	**Private key and Public key cryptosystems** - One way functions - Discrete log problem – Factorization problem - RSA encryption -Diffie Hellmann key exchange. Message authentication and hash functions - Digital signatures - Secret sharing - features of visual cryptography - other applications of cryptography	**17**	**25%**
IV	**Elliptic curves** - Basic theory - Weirstrass equation - Group law - Point at Infinity Elliptic curves over finite fields - Discrete logarithm problem on EC - Elliptic curve cryptography - Diffie Hellmann key exchange over EC - Elgamal encryption over EC - ECDSA	**13**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC6262	**ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY**	**3-0-0-3**	**2015**

Syllabus

EMI/EMC Concepts, EMI Coupling Principles, EMI Control Techniques, EMI Measurements and Standards.

References:

1.V.P.Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press, Newyork, 1996.
2.Clayton R.Paul,” Introduction to Electromagnetic Compatibility”, John Wiley Publications, 2008
3.Bemhard Keiser, “Principles of Electromagnetic Compatibility”, 3rd Ed, Artech house, Norwood, 1986.
4.Don R.J.White Consultant Incorporate, “Handbook of EMI/EMC” , Vol I-V, 1988.

Course Plan

Module	content	Hours	Semester Exam Marks
I	**EMI/EMC Concepts** EMI Environment – Sources and victim of EMI, conducted and radiated EMI Emission and susceptibility, Transient EMI, EMI-EMC definitions, units, parameters. ESD, Radiation Hazards	**16**	**25%**

II	**EMI Coupling Principles** EMI coupling principles-Conducted, Radiated and Transient Coupling, Common Impedance Ground Coupling, Radiated Common Mode and Ground Loop Coupling, Radiated Differential Mode Coupling, near field cable to cable coupling. Power mains and power supply coupling.	**16**	**25%**
First Internal Exam			
III	**EMI Control Techniques** Shielding- Shielding Material-Shielding integrity at discontinuities, Filtering-Characteristics ofFilters- Impedance and Lumped element filters-Telephone line filter, Power line filter design, Grounding- Measurement of Ground resistance-system grounding for EMI/EMC-Cable shielded grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control.	**15**	**25%**
IV	**EMI Measurements and Standards** EMI specifications: standards, limits - units of specifications, Civilian and Military standards. EMI measurements – EMI test instruments, systems, EMI test, EMI shielded chamber, Open area test site, TEM cell Antennas, conductors, sensors, injectors, couplers, calibration procedure, EMC design of PCB – PCB traces cross talk, impedance control, power distribution decoupling, zoning, motherboard designs.	**15**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC6272:	**PHOTONIC SWITHCHING AND OPTICAL NETWORKS**	**3-0-0-3**	**2015**

Syllabus

Introduction to optical networks, Optical Add/DropMultiplexers-OADM Architecture, Reconfigurable OADMs, Transmitters, Detectors, Switches, Wavelength Convertor. Client layer of Optical Networks, Control and Management, Requirement of Optical Layer Protection and Protection Schemes. Access network: Photonic packet switching, Optical TDM.

References

1.Rajiv Ramaswami, Kumar N Sivarajan and Galen H. Sasaki, Optical Networks - A practical perspective, 3rd edition Morgan Kaufmann,2009.

2.E.A.Saleh, M.C.Teich, Fundamentals of photonics, Wiley Interscience, 1991

3.Martin Maier, Optical switching networks, 1st edition Cambridge University Press,2009.

4.J.Singh, Optoelectronics: An introduction to materials and devices, McGraw Hill, 1996

5.J.Wilson and J.F.B Hawkes, Optoelectronics: An introduction, Prentice Hall India, 1998.

Course Plan

Module	content	Hours	Semester Exam Marks
I	Introduction to optical networks: The optical layer, Transparency and All Optical Networks, Optical Packet Switching. Transmission Basics, Propagation of Signals in Optical Fibers: Nonlinear Effects. WDM network elements-Optical Line Terminals (OLTs), Optical Add/DropMultiplexers-OADM Architecture, Reconfigurable OADMs, Transmitters, Detectors, Switches, Wavelength Convertor.	**15**	**25%**

II	Client layer of Optical Networks- SONET/SDH, Ethernet, IP, Storage-area Networks. WDM Network Design: LTD and RWA problems, Dimensioning Wave-length Routing Networks, Statistical dimensioning Models, Maximum Load Dimensioning Models.	**15**	**25%**
First Internal Exam			
III	Control and Management- Network Management Function, Optical Layer Services and Interfacing, Layers within Optical Layer, Performance and Fault Management, Configuration Management and Optical Safety. Network Survivability- Protection in SONET/SDH, Protection in IP Networks. Requirement of Optical Layer Protection and Protection Schemes.	**15**	**25%**
IV	Access network: Photonic packet switching, Optical TDM, Synchronization, Header Processing, Buffering, Burst switching, Deployment considerations, Designing transmission layer.	**12**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC6282	**ADHOC NETWORKS**	**3-0-0-3**	**2015**

Syllabus

Ad Hoc wireless networks: Issues in Ad Hoc Wireless Networks, Contention- Based MAC Protocols with Scheduling Mechanisms. MAC Protocols that Use Directional Antennas. Other MAC Protocols. Routing Protocols for Ad Hoc Wireless Networks, Quality of Service in Ad Hoc Wireless Networks, Transport Layer and Security Protocols for Ad Hoc Wireless Networks, Network Security Attacks. Key Management. Secure Routing in Ad Hoc Wireless Networks. Wireless Sensor Networks, The Multimode 802.11 -IEEE 802.11a/b/g. The Meghadoot Architecture.

References

1.Siva Ram Murthy, B.S Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Prentice Hall,2004.

2.Prasanth Mohapathra, S. Krishnamurthy, Adhoc Networks: Technologies and standards, Springer, 2004

Course Plan

Module	content	Hours	Semester Exam Marks
I	Ad Hoc wireless networks: Issues in Ad Hoc Wireless Networks. Ad Hoc Wireless Internet MAC Protocols for Ad Hoc Wireless Networks: Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks. Design Goals of a MAC Protocol for Ad Hoc Wireless Networks. Classifications of MAC Protocols. Contention-Based Protocols. Contention-Based Protocols with Reservation Mechanisms. Contention- Based MAC Protocols with Scheduling Mechanisms. MAC Protocols that Use Directional Antennas. Other MAC Protocols.	**16**	**25%**

II	Routing Protocols for Ad Hoc Wireless Networks: Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks. Classifications of Routing Protocols. Table-Driven Routing Protocols.On-Demand Routing Protocols. Hybrid Routing Protocols. Routing Protocols with Efficient Flooding Mechanisms. Hierarchical Routing Protocols. Power-Aware Routing Protocols. Quality of Service in Ad Hoc Wireless Networks: Issues and Challenges in Providing QoS in Ad Hoc Wireless Networks. Classifications of QoS Solutions.MAC Layer Solutions. Network Layer Solutions. QoS Frameworks for Ad Hoc Wireless Networks.	**16**	**25%**
First Internal Exam			
III	Transport Layer and Security Protocols for Ad Hoc Wireless Networks: Introduction. Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks. Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks. Classification of Transport Layer Solutions. TCP Over Ad Hoc Wireless Networks. Other Transport Layer Protocols for Ad Hoc Wireless Networks. Security in Ad Hoc Wireless Networks. Network Security Requirements. Issues and Challenges in Security Provisioning. Network Security Attacks. Key Management. Secure Routing in Ad Hoc Wireless Networks.	**15**	**25%**
IV	Wireless Sensor Networks: Sensor Network Architecture. Data Dissemination. Data Gathering. MAC Protocols for Sensor Networks. Location Discovery. Hybrid Wireless Networks: Next- Generation Hybrid Wireless Architectures. Routing in Hybrid Wireless Networks. Pricing inMulti-Hop Wireless Networks. Power Control Schemes in Hybrid Wireless Networks. Load Balancing in Hybrid Wireless Networks Recent Advances in Wireless Networks. Introduction. Ultra-Wide-Band Radio Communication. Wireless Fidelity Systems. Optical Wireless Networks. The Multimode 802.11 -IEEE 802.11a/b/g. The Meghadoot Architecture.	**15**	**25%**
Second Internal Exam			

End semester Exam

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC6902	**MINI PROJECT**	**0-0-4-2**	**2015**

The mini project is designed to develop practical ability and knowledge about practical tools/techniques in order to solve the actual problems related to the industry, academic institutions or similar area. Students can take up any application level/system level project pertaining to a relevant domain and must be done within the institution. Projects can be chosen either from the list provided by the faculty or in the field of interest of the student. The project guide should have a minimum qualification of ME/M.Tech in relevant field of work. At the end of each phase, presentation and demonstration of the project should be conducted, which will be evaluated by a panel of examiners. A detailed project report duly approved by the guide in the prescribed format should be submitted by the student for final evaluation. Publishing the work in Conference Proceedings/ Journals with National/ International status with the consent of the guide will carry an additional weightage in the review process.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC 6822	COMMUNICATION ENGINEERING LAB II	0-0-2-1	2015

All the students are expected to do laboratory experiments based on a minimum three courses that they have undergone in that semester. The PG course coordinator, in consultation with the faculty who are offering the various subjects, and the faculty incharge of the PG laboratory should frame syllabus covering fundamental concepts, design, and implementation of simple applications based on the theory papers the students have undergone during the semester.

Tools: MATLAB, AWR or equivalent tools and other simulation tools

Experiments:

1. Familiarization of network simulation tools like NS2.
2. Routing protocols for wired networks-Link state, distance vector.
3. Routing protocols for wireless networks-AODV,DSR.
4. Comparision of TCP and UDP and its performance analysis.
5. OFDM system simulation and its BER performance.
6. Implementation of MIMO system.
7. Implementation of basic LMS and RLS algorithm.

SEMESTER III

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC 7203	**HIGH FREQUENCY CIRCUIT DESIGN**	**3-0-0-3**	**2015**

Syllabus:

Transmission line theory Review of Transmission line theory,SWR, and impedance mismatches. Planar transmission lines.Smith chart, RF filter design overview;Impedance matching networks, quarter –wave transformer.Frequency transformation,Basics of MIC, MMIC and MEMS technologie,RF Amplifiers, Oscillators, Mixers and their characteristics,high frequency oscillator configurations, basic characteristics of mixers. Basic series and shunt switches in microstrip; SPST and SPDT switches.

References

1.Reinhold Ludwig & Powel Bretchko, "RF Circuit Design-Theory and applications" '

1st ed., Pearson education Ltd., 2004.

2.Mathew M Radmanesh,"Advanced RF & Microwave circuit design- The ultimate guide to system design", Pearson Education Asia,2009.

3. David M Pozar,"Microwave Engineering", 3rd ed., Wiley India, 2007.

4.B Bhat & S.K.Koul ,Stripline –like transmission line for Microwave Integrated Circuits, New Age Intl.(P) Ltd.,1989

Course Plan

MODULE	CONTENT	HOURS	SEMESTER EXAM MARKS
I	Transmission line theory Review of Transmission line theory: - Lumped element model, Field analysis of transmission lines, terminated lossless lines, SWR, and impedance mismatches. Planar transmission lines: - strip line, microstrip, coplanar – line .Smith chart: reflection coefficient, load impedance, impedance transformation, admittance transformation, and parallel and series connection. Revision of S- parameters. RF filter design overview; Basic resonator and filter configuration, Special filter realizations, filter implementations, coupled filter.	**16**	**25%**
II	Impedance matching networks, impedance matching using discrete components, microstrip line matching networks, single stub matching network, double stub matching network, quarter –wave transformer.	**16**	**25%**
First Internal Exam			
III	Frequency transformation, high impedance /low impedance low pass filter, parallel coupled bandpass filter, Spur line band stop filter. Basics of MIC, MMIC and MEMS technologies- substrate used, fabrication process, relative advantages.	**15**	**25%**

IV	RF Amplifiers, Oscillators, Mixers and their characteristics, amplifier power relations, stability consideration. Basic oscillator model, high frequency oscillator configurations, basic characteristics of mixers. Basic series and shunt switches in microstrip; SPST and SPDT switches.	**15**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	**Course Name**	**L-T-P-Credits**	**Year of Introduction**
03EC 7213	**COMMUNICATION SWITCHING AND MULTIPLEXING**	**3-0-0-3**	**2015**

Syllabus:

Switching: Performance and architectural issues: Packet switches-Circuit switches. Generalized circuit switching-Cross Point Complexity (CPC)-Fast packet switching-Self routing Banyan network.Traffic analysis: Little's theorem, Erlang-C formula , M/G/1 model.Types of blocking for a packet switch- Output conflicts- HOL blocking. The Lee approximation – The Jacobaeus method.Multiplexing: Network performance and source characterization; Stream sessions in packet networks, deterministic analysis, stochastic analysis, circuit multiplexed networks.

References

1.A.Kumar, D. Manjunath, J. Kuri, Communication Networking: An Analytical Approach, Morgan Kaufman Publishers,First Edition 2004.

2.Hui, J.Y., Switching and Traffic Theory for Integrated Broadband Networks, Kluwer Academic Publishers, 1990.

3.John C. Bellamy, Digital Telephony, Third Edition, Wiley, 2000.

Course Plan

MODULE	CONTENT	HOURS	SEMESTER EXAM MARKS
I	Switching: Performance and architectural issues: Packet switches-Circuit switches. Time and Space division switching -Point to point circuit switching -multistage switching network -Paull's matrix for representing connections -Strict sense non blocking Cross network. Generalized circuit switching-Cross Point Complexity (CPC)-Fast packet switching-Self routing Banyan networks-Combinatorial limitations of Banyan networks	**16**	**25%**

II	Traffic analysis: Traffic measurements, arrival distributions, Poisson process, holding/service time distributions, loss systems, lost calls cleared –Erlang-B formula, lost calls returning and lost calls held models, lost calls cleared and held models with finite sources, delay systems, Little's theorem, Erlang-C formula , M/G/1 model.	**16**	**25%**
First Internal Exam			
III	Types of blocking for a packet switch- Output conflicts- HOL blocking. Blocking probability: Analysis of single stage and multistage networks –Blocking for Unique path routing-Alternate path routing- The Lee approximation – The Jacobaeus method.	**15**	**25%**
IV	Multiplexing: Network performance and source characterization; Stream sessions in packet networks, deterministic analysis, stochastic analysis, circuit multiplexed networks.	**15**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC 7223	**WIRELESS SYSTEMS AND STANDARDS**	**3-0-0-3**	**2015**

Syllabus:

Introduction to Mobile Communication SystemsHandoff strategies – Interference and System capacity – Trunking and Grade of service – Improving capacity in cellular systems.GSM, GPRS, 3G Standards,3G UMTS network architecture – UMTS services and features.Multiple Access Techniques,OFDMA/MIMO/SC-FDMA, OFDM/MIMO.Wireless NetworkingCordless systems and Wireless Local Loop (WLL) – IEEE 802.16 Fixed Broadband Wireless Access standard, WIMAX, Mobile IP and Wireless Application Protocol.

References:

1.Rappaport, T.S., "Wireless Communications, Principles and Practice", 2ndEdition, Prentice Hall, NJ, 2002.

2.SimonHaykin&Michael Moher,"ModernWirelessCommunications",Pearson Education, 2007.

3.William Stallings, "Wireless Communications and Networks", 2ndEdition, Pearson Education, 2005.

4.Gordon L. Stuber, "Principles of Mobile Communication",Third Edition,Springer International Edition 2001.

Course Plan

MODULE	CONTENT	HOURS	SEMESTER EXAM MARKS
I	Evolution of Mobile radio communications – Brief History of Wireless systems and standards. Cellular concept – Frequency reuse – Channel Assignment strategies – Handoff strategies – Interference and System capacity – Trunking and Grade of service – Improving capacity in cellular systems.	**16**	**25%**
II	GSM services and features – GSM system architecture – GSM radio subsystem – Frame structure for GSM – Signal processing in GSM – GPRS network architecture – GPRS services and features – 3G UMTS network architecture – UMTS services and features.	**16**	**25%**
First Internal Exam			
III	Multiple access techniques – FDMA, TDMA, TDMA/FDD, CDMA, SDMA and OFDMA/MIMO/SC-FDMA, OFDM/MIMO.	**15**	**25%**

IV	Wireless networking – Design issues in personal wireless systems –Examples of Mobile radio systems- Cordless systems and Wireless Local Loop (WLL) – IEEE 802.16 Fixed Broadband Wireless Access standard, WIMAX, Mobile IP and Wireless Application Protocol.	**15**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC 7233	**EMBEDDED COMMUNICATION SYSTEMS**	**3-0-0-3**	**2015**

Syllabus:

Embedded Communication Protocols

Embedded Networking: Introduction – Serial/Parallel Communication -ISA/PCI Bus protocols - Firewire.USB and CAN Bus,PIC 18 Microcontroller USB Interface – C Programs –CAN Bus – PIC microcontroller CAN Interface –A simple application with CAN,Ethernet Basics,Design choices: Selecting components –Ethernet Controllers,Inside the Internet protocol,Embedded Ethernet, Serving web pages with Dynamic Data – Serving web pages that respond to user Input – Email for Embedded Systems – Using FTP – Keeping Devices and Network secure.

References:

1. Frank Vahid, Givargis "Embedded Systems Design: A Unified Hardware/Software Introduction", Wiley Publications, 2006

2. Dogan Ibrahim, "Advanced PIC microcontroller projects in C", Elsevier 2008

3. Jan Axelson "Embedded Ethernet and Internet Complete", Penram publications, 2007

Course Plan

MODULE	CONTENT	HOURS	SEMESTER EXAM MARKS

I	**Embedded Communication Protocols** Embedded Networking: Introduction – Serial/Parallel Communication – Serial communication protocols -RS232 standard – RS485 – Synchronous Serial Protocols - Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – PC Parallel port programming -ISA/PCI Bus protocols - Firewire.	**16**	**25%**
II	**USB and CAN Bus** USB bus – Introduction – Speed Identification on the bus – USB States – USB bus communication: Packets –Data flow types – Enumeration –Descriptors –PIC 18 Microcontroller USB Interface – C Programs – CAN Bus – Introduction - Frames – Bit stuffing –Types of errors – Nominal Bit Timing – PIC microcontroller CAN Interface – A simple application with CAN	**16**	**25%**
First Internal Exam			
III	**Ethernet Basics** Elements of a network – Inside Ethernet – Building a Network: Hardware options – Cables, Connections and network speed – Design choices: Selecting components – Ethernet Controllers – Using the internet in local and internet communications – Inside the Internet protocol	**15**	**25%**

IV	**Embedded Ethernet** Exchanging messages using UDP and TCP – Serving web pages with Dynamic Data – Serving web pages that respond to user Input – Email for Embedded Systems – Using FTP – Keeping Devices and Network secure.	**15**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC 7243	MODELING AND SIMULATION OF COMMUNICATION SYSTEMS	3-0-0-3	2015

Syllabus:

Introduction to Simulation and Modeling M**ethodology**,Simulation Sampling Frequency. Simulation Models For Bandpass Signals And Systems - Linear Bandpass Systems, Non Linear And Time Varying Systems.Generation Of Random Signals, Uniform Random Number Generators, Mapping Uniform Rvs To An Arbitrary Pdf, **Monte Carlo Simulation**, Semianalytic techniques, Case study: Performance estimation of a wireless system.Modelling of communication system and channel models, Digital channel model-Gilbert model of bustry channels, HF, Troposcatter and satellite channels, Efficient Simulation Techniques simulation methodology – modeling co-channel interference -two example simulations; A code-division multiple access system - FDM system with a nonlinear satellite transponder - preprocessors for CDMA application. Simulation of networks: Network Layout and Reliability, Study of Network Simulator NS – 2

References:

1.W.Tranter, K. Shanmugan, T. S. Rappaport, K L. Kosbar, “Principles of Communication Systems Simulation With Wireless Applications”, Pearson Education, 2004.

2.M. C. Jeruchim, P. Balaban, and K. S. Shanmugan, "Simulation of Communication Systems: Modeling, Methodology, And Techniques", 2nd Edition, Kluwer Academic/Plenum Publishers, 2000.

3.J. G. Proakis, M. Salehi, G. Bauch, “Contemporary Communication Systems Using Matlab and Simulink”, 2nd Edition, Thomson Engineering, 2004.

Course Plan

MODULE	CONTENT	HOURS	SEMESTER EXAM MARKS
I	Role Of Simulation-Basic Concepts of Modeling- Error Sources In Simulation-Validation –Performance Evaluation. Fundamental Concepts of Sampling, Quantization, Reconstruction, Simulation Sampling Frequency. Simulation Models For Bandpass Signals And Systems - Linear Bandpass Systems, Non Linear And Time Varying Systems.	**16**	**25%**
II	Generation Of Random Signals, Uniform Random Number Generators, Mapping Uniform Rvs To An Arbitrary Pdf, Generating Uncorrelated And Correlated Gaussian Random Numbers, PN Sequence Generators Monte Carlo Simulation : Fundamental concepts, Application to communication systems, Monte Carlo integration, Semianalytic techniques, Case study: Performance estimation of a wireless system.	**16**	**25%**
First Internal Exam			

III	Modelling of communication system and channel models: Model of speech and picture signals,Pseudo noise sequences, Non-linear sequences, Analog channel model, Noise and fading, Digital channel model-Gilbert model of bustry channels, HF, Troposcatter and satellite channels, Switched telephone channels, Analog and Digital communication system models, Light wave system models	**15**	**25%**
IV	**Efficient Simulation Techniques :** Tail Extrapolation: PDF estimators- importance sampling; Case study of a cellular radio system; Cellular radio system - simulation methodology – modeling co-channel interference -two example simulations; A code-division multiple access system - FDM system with a nonlinear satellite transponder - preprocessors for CDMA application. **Simulation of networks:** Network Layout and Reliability, Study of Network Simulator NS – 2	**15**	**25%**
Second Internal Exam			
End semester Exam			

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC7253	SIGNAL COMPRESSION THEORY AND METHODS	3-0-0-3	2015

Syllabus:

Review of Information Theory,Compression Techniques --Lossless and Lossy Compression - Mathematical Preliminaries for Lossless Compression ,Lempel Ziv coding, Applications - Predictive Coding - Prediction with Partial Match - Burrows Wheeler Transform, Dynamic Markov Compression,Rate distortion theory, Quantization , Optimality conditions for VQ, Predictive Coding - Differential Encoding Schemes,Mathematical Preliminaries for Transforms: Karhunen Loeve Transform, Discrete Cosine and Sine Transforms, Discrete Walsh Hadamard Transform,Wavelet Based Compression , Analysis/Synthesis Schemes.Data Compression standards. Speech Compression Standards. Audio Compression standards.Video Compression Standards.

References:

1.Khalid Sayood, "Introduction to Data Compression", Morgan Kaufmann Publishers.,2nd Edn., 2005

2.David Salomon, "Data Compression: The Complete Reference", Springer Publications, 4th Edn.,2006

3.Thomas M. Cover, Joy A. Thomas, "Elements of Information Theory," John Wiley & Sons, Inc. 1991

4.N. S Jayant, Peter Noll, Digital Coding of Waveforms: Principles and Applications to Speech and Video, Prentice Hall Inc. 1984.

5.Toby Berger, Rate Distortion Theory: A Mathematical Basis for Data Compression, Prentice Hall, Inc.1971

6. .K.R.Rao, P.C.Yip, "The Transform and Data Compression Handbook", CRC Press,2001

Course Plan

MODULE	CONTENT	HOURS	SEMESTER EXAM MARKS
I	Review of Information Theory: The discrete memoryless information source – Kraft inequality; optimal codes Source coding theorem. Compression Techniques -- Lossless and Lossy Compression - Mathematical Preliminaries for Lossless Compression -Huffman Coding - Optimality of Huffman codes - Extended Huffman Coding – Adaptive Huffman Coding - Arithmetic Coding - Adaptive Arithmetic coding, Run Length Coding, Dictionary Techniques – Lempel Ziv coding, Applications - Predictive Coding - Prediction with Partial Match - Burrows Wheeler Transform, Dynamic Markov Compression	**16**	**25%**

II	Rate distortion theory: Rate distortion function R(D),Properties of R(D); Calculation of R(D) for the binary source and the Gaussian source, Rate distortion theorem, Converse of the Rate distortion theorem, Quantization : Uniform & Non-uniform , optimal and adaptive quantization, vector quantization and structures for VQ, Optimality conditions for VQ, Predictive Coding - Differential Encoding Schemes	**16**	**25%**
First Internal Exam			
III	Mathematical Preliminaries for Transforms: Karhunen Loeve Transform, Discrete Cosine and Sine Transforms, Discrete Walsh Hadamard Transform, Lapped transforms - Transform coding , Subband coding , Wavelet Based Compression , Analysis/Synthesis Schemes	**15**	**25%**
IV	Data Compression standards: Zip and Gzip, Speech Compression Standards: PCM, ADPCM, SBC, CELP, MPC,MLQ, MELP, LPC. Audio Compression standards: MPEG Image Compression standards: JBIG, GIF, JPEG & JFIF, SPIHT, EZW, JPEG 2000. Video Compression Standards: MPEG, H.261, H.263 & H264.	**15**	**25%**
Second Internal Exam			

End semester Exam

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC 7903	**SEMINAR**	**0-0-2-2**	**2015**

Each student shall present a seminar on any topic of interest related to the core/elective courses of the M. Tech. Programme. He / She shall select the topic based on the references from recently published international journals of repute, preferably IEEE/ACM/Springer journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester. Marks will be awarded based on the topic, presentation, participation in the seminar and the report submitted.

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC 7913	**PROJECT (PHASE I)**	**0-0-8-6**	**2015**

For the Project (Phase – I) the student is expected to start the preliminary background studies towards the project by conducting a literature survey in the relevant field. He/she should broadly identify the area of the project work, familiarize with the design and analysis tools required for the project work and plan the experimental platform, if any, required for project work. The student will submit a detailed report of these activities at the end of the semester.

SEMESTER IV

Course No.	Course Name	L-T-P-Credits	Year of Introduction
03EC 7914	**PROJECT (PHASE II)**	**0-0-21-21**	**2015**

The student is expected to continue the thesis phase I and after successfully completing the work he/she has to submit a detailed bounded thesis report. The work carried out should lead to publication in National/International conference or Journal.