E.G.S.PILLAYENGINEERINGCOLLEGE

(Autonomous)

Approved byAICTE,NewDelhi|Affiliated to AnnaUniversity, Chennai

Accredited byNAAC with „A"Grade|AccreditedbyNBA(CSE, EEE, MECH)

NAGAPATTINAM–611002

B.E.Electronicsand CommunicationEngineering

FullTimeCurriculumand Syllabus

ThirdYear– SixthSemester

Course Code	CourseName	L	T	P	C	Maximum Marks		
						CA	ES	Total
Theory Course								
1701MGX01	Professional Ethics	2	0	0	2	40	60	100
1702EC601	VLSI Design	3	0	0	3	40	60	100
1702EC602	Digital Communication	3	0	0	3	40	60	100
1702EC603	Wireless Networks and Standards	3	0	0	3	40	60	100
	Professional Elective - III	3	0	0	3	40	60	100
	Professional(Open) Elective – IV	3	0	0	3	40	60	100
LaboratoryCourse								
1702EC651	VLSI Design Laboratory	0	0	2	1	50	50	100
1702EC652	Communication and Networks Laboratory	0	0	2	1	50	50	100
	Industrial Visits & Presentation	0	0	0	1	100	-	100
	Life Skills: Aptitude - II	0	0	2	1	100	-	100
	Total	**18**	**0**	**6**	**21**	**540**	**460**	**1000**

Professional (Open)Elective - III								
1703EC601	Information Theory and Coding	3	0	0	3	40	60	100
1703EC602	Digital Control Engineering	3	0	0	3	40	60	100
1703EC603	**Network Security**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
1703EC604	Real Time Operating Systems	3	0	0	3	40	60	100
1703EC605	**Soft Computing**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
Professional Elective – IV								
1703EC813	Cloud Computing	3	0	0	3	40	60	100
1703EC814	Internet of Things (IoT)	3	0	0	3	40	60	100
1703EC815	Big Data Analytics	3	0	0	3	40	60	100
1703EC816	**Introduction to Web Technology**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
1703EC817	Grid Computing	3	0	0	3	40	60	100

L–Lecture|T–Tutorial|P–Practical|C–Credit|CA –ContinuousAssessment| ES–EndSemester

1701MGX01	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

Course Objectives:

1.To provide basic knowledge about engineering Ethics, Variety of moral issues and Moral dilemmas, Professional Ideals and Virtues

2.To provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards, Exposure to Safety and Risk, Risk Benefit Analysis

3.To have an idea about the Collegiality and Loyalty, Collective Bargaining, Confidentiality, Occupational Crime, Professional, Employee, Intellectual Property Rights

4. To have an adequate knowledge about MNC's, Business, Environmental, Computer Ethics, Honesty, Moral Leadership, sample Code of Conduct.

5.To use the engineering principles to update and maintain the technical skills.

Unit I **I ENGINEERING ETHICS** **9 Hours**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

Unit II **II ENGINEERING AS SOCIAL EXPERIMENTATION** **9 Hours**

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study.

Unit III **ENGINEER'S RESPONSIBILITY FOR SAFETY** **9 Hours**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Case Studieson Chernobyl, Bhopal MIC and Sterlite copper.

Unit IV **RESPONSIBILITIES AND RIGHTS** **9 Hours**

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

Unit V **GLOBAL ISSUES** **9 Hours**

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

Total: 45 Hours

Further Reading:

Case study on Hiroshima and Nagasaki

Course Outcomes:

After completion of the course, Student will be able to

1. Helps to examine situations and to internalize the need for applying Ethical principles, values to tackle with various situations.
2. Develop a responsible attitude towards Global issues
3. Envision the societal impact on the products/ projects
4. Understanding the code of ethics and standards
5. Apply ethics in society, discuss the global issues related to engineering and realize the responsibilities and rights in the society

References:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi 2004
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003)

1702EC601	VLSI DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the CMOS Fabrication Process and CMOS Circuits
2. To study CMOS Circuits using various Logic Styles
3. To provide basic knowledge about Clocking, Memory and VLSI Subsystem Design

UNIT I **FABRICATION OF CMOS IC AND PHYSICAL DESIGN** **9 Hours**

An overview of Silicon Semiconductor technology- NMOS fabrication - CMOS fabrication: n-well, pwell- Twin tub and SOI Process- Layout design rules- Lambda Design Rules Stick Diagrams-VLSILayout Design -Full Custom and Semi Custom Layout- Layout of Basic Structures - CMOS Logic Gates- Implementation of given logic function using CMOS logic-Basics of MEMS.

UNIT II **MOS CIRCUIT DESIGN PROCESS** **9 Hours**

Pass Transistor and Transmission Gate Static CMOS design, Tri-State Circuits- Pseudo Nmos–dynamicCMOS logic Clocked CMOS logic Precharged domino logic- Keeper Circuits - Dual Rail- CascodeVoltage Switch Logic-Circuit Pit Falls

UNIT III **CMOS LOGIC STYLES** **9 Hours**

National and International standardizing organizations – FCC, CISPR, ANSI, DOD, IEC, CENEEC, FCC CE and RE standards – CISPR, CE and RE Standards, IEC/EN, CS standards – Frequency assignment – spectrum conversation.

UNIT IV **CMOS MEMORIES AND CLOCKING** **9 Hours**

Conventional CMOS Latches CMOS D Flip Fop SDFF - TSPC Flip Flop - CMOS Static RAM Dual PortSRAM - SRAM Arrays - DRAM and Floating Gate MOSFET - Flash Memory CMOS Clocking StylesPipelined Systems

UNIT V **VLSI SUBSYSTEM DESIGN** **9 Hours**

CMOS Mux - Equality Detector - Shift and Rotation Operation - Parity generators- Ripple Carry Adder-Carry Look Ahead Adder -Carry Skip Adder - Carry select - Carry save-Array - Braun/ Baugh Wooley -Modified Booth Encoded Multiplier

Total: 45 Hours

Further Reading: Comparison of Logic Styles - Differential and Sense Amplifier Circuits Prescaler - Bit Slice – ALU CMOS Clock Generation and Distributions - BICMOS- FINFET Technology

Course Outcomes:

After completion of the course, Student will be able to

1. Demonstrate CMOS Fabrication process and Layout Design.
2. Analyze MOS Circuit Design Process.
3. Design the circuits using Various Logic Styles
4. Reveal the operation of CMOS Memory and Clocking Strategies
5. Design building block of VLSI system.

References:

1. John P.Uyemura, "Introduction to VLSI circuits and systems", John Wiley & Sons, 2015
2. Neil.H.EWeste David Harris CMOS VLSI Design: A Circuits and Systems Perspective, 4th edition, Pearson Addison Wesley, 2015.
3. Kamran Eshraghian, Douglas A. Pucknell, Essentials of VLSI Circuits and Systems Prentice Hall of India, 2015.
4. E. Fabricious, Introduction to VLSI Design, 1st edition, McGraw Hill, 2014
5. Keng,Lablebick,"CMOS Digital Integrated Circuits", Tata McGraw Hill, 2014

1702EC602	DIGITAL COMMUNICATION	L	T	P	C
		3	0	0	3

Course Objectives:

1. To know the principles of quantization and waveform coding
2. To apply the concepts of Error control coding.
3. To understand the various Band pass signaling schemes.
4. To understand the principles of spread spectrum.

UNIT I	QUANTIZATION AND CODING	9 Hours

Review of Sampling and Reconstruction, Quantization and Encoding, Waveform coding – PCM,DPCM,DM,ADM, Linear Predictive Coding.

UNIT II	ERROR CONTROL CODING TECHNIQUES	9 Hours

Channel coding theorem – Linear block codes – Hamming codes – Cyclic codes – Convolutionalcodes – Viterbi decoding.

UNIT III	INTRODUCTION TO INFORMATION THEORY	9 Hours

Measure of information – Entropy – Source coding theorem – Discrete memory less channels–lossless, deterministic, noiseless, BEC, BSC – Mutual information – Channel capacity – Shannon Hartley law-Transform coding – LPC – Shannon-Fano coding, Huffman Coding, Run length coding, LZW algorithm.

UNIT IV	DIGITAL TRANSMISSION TECHNIQUES	9 Hours

Matched filter detection-Intersymbol Interference, Eye pattern - Generation and detection of BPSK, BFSK, QPSK, DPSK, MSK,GMSK,QAM - BER and Power spectral Density Comparison.

UNIT V	SYNCHRONISATION AND SPREAD SPECTRUM TECHNIQUES	9 Hours

Importance of Synchronisation – Carrier, frame and symbol/Chip synchronization techniques,Spread Spectrum - PN Sequences, Direct Sequence and Frequency Hopping Spread SpectrumSystems, BER Analysis, Processing gain and Jamming Margin.

Total:	45 Hours

Further Reading: Frequency of Spread Spectrum – TDMA – FDMA – CDMA – OFDMA.

Course Outcomes:

After completion of the course, Student will be able to

1. Design and implement the quantization and waveform coding
2. An ability to apply the concepts of Error control coding.
3. Capable of configuring Source coding schemes
4. Design and implement band pass signaling schemes.
5. Knowledge on the principle of spread spectrum.

References:

1. Simon Haykin, “Digital Communications”, John Wiley, 2015.
2. J.G Proakis, ―Digital Communication‖, 5/e, Tata Mc Graw Hill Company, 2008.
3. Bernard Sklar, “Digital Communication”, 2nd Edition, Pearson Education, 2006.
4. Herbert Taub & Donald L Schilling , “Principles of Communication Systems”, 3rd Edition, Tata McGraw Hill, 2008.
5. H P Hsu, Schaum Outline Series- ―Analog and Digital Communications‖, TMH 2006 .

1703EC603	WIRELESS NETWORKS AND STANDARDS (Common to B.E / B.Tech – CSE, IT & ECE)	L	T	P	C
		3	0	0	3

Course Objectives:

1. To study about Wireless networks, protocol stack and standards.
2. To study about fundamentals of 3G Services, its protocols and applications.
3. To study about evolution of 4G Networks, its architecture and applications.

Unit I	WIRELESS NETWORK ARCHITECTURE	9 Hours

Introduction-Wireless network logical architecture – Network physical architecture- Wireless LAN standards: System architecture, protocol architecture, physical layer, MAC layer, 802.11 Enhancements – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth- VoWLAN and VoIP security – WPA- IEEE802.16-WIMAX: Physical layer, MAC, Spectrum allocation for WIMAX

Unit II	MOBILE NETWORKS LAYER	9 Hours

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6- Mobile ad-hoc network: Routing, Destination Sequence distance vector, Dynamic source routing- Characteristics of MANETs, Table-driven and Source-Initiated On Demand routing protocols, Hybrid protocols, Wireless Sensor networks-Classification, MAC and Routing protocols.

Unit III	PROTOCOLS AND TCP/IP SUITE	9 Hours

The Need for a Protocol Architecture - The TCP/IP Protocol Architecture - The OSI Model - Internetworking TCP enhancements for wireless protocols - Traditional TCP: Windows based Congestion control, fast retransmit/fast recovery, Influences of mobility on TCP mechanism - Classical TCP improvements: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing, Selective retransmission, Transaction oriented TCP - TCP over 3G wireless networks

Unit IV	DESIGN OF WIRELESS WIDE AREA NETWORK	9 Hours

Basics of indoor RF planning- Three phases of wireless network design- Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: link budgets for GSM, CDMA, 3G-MSC, 3G- SGSN, 3G-GGSN, SMS-GMSC/SMS-IWMSC, Firewall, DNS/DHCP-High speed Downlink packet access (HSDPA)systems - LTE network architecture and protocol.

Unit V	CURRENT AND FUTURE OF WIRELESS NETWORKING TECHNOLOGY	9 Hours

Introduction – 4G vision – 4G features and challenges - Applications of 4G – Leading edge WNT: Wireless mesh network routing- Network independent roaming- Gigabit wireless LANs- OFDM-MIMO systems, Adaptive Modulation and coding with time slot scheduler, Cognitive Radio.

Total:	45 Hours

Further Reading:

Signal Encoding Techniques, Cordless Systems and Wireless Local Loop

Equalization, Coding, and Diversity, Heterogeneous Wireless Networks

Course Outcomes:

After completion of the course, Student will be able to

1. Conversant with the latest 3G/4G and WiMAX networks and its architecture.
2. Design and implement Routing Techniques
3. Analyze wireless network environment for any application using latest wireless protocols and standards.
4. Compare and Analyze the Different types Networks
5. Implement different type of applications for smart phones and mobile devices with latest network strategies.

References:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, "Wireless Networking", First Edition, Elsevier 2011.
3. Simon Haykin , Michael Moher, David Koilpillai, "Modern Wireless Communications", First Edition, Pearson Education 2013

17EC651	VLSI DESIGN LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1. To gain expertise in design, development and simulation of digital circuits with Verilog HDL.
2. To apply concepts and methods of digital system design techniques through hands-on experiments.
3. To develop skills, techniques and learn state-of-the-art engineering tools (such as HDL, Xilinx tools)

List of Experiments:

I. Design and simulation of Combinational Logic Circuit using Verilog HDL

1. Adder – Carry Select & Carry Save, Multiplexer and Demultiplexer, Encoder and Decoder
2. Multiplier

II. Design and simulation of Sequential Logic Circuit using Verilog HDL

3. Flip-flops, Counters, Shift Registers
4. Frequency Dividers

III. CMOS Circuit design using SPICE (DC and Transient Analysis)

5. CMOS Inverter
6. CMOS NAND and NOR Gates
7. CMOS Latch

IV. FPGA Implementation

8. 4 bit Adder
9. 4x4 Multiplier
10. ALU Design

Total: 45 Hours

Additional Experiments:

1. Synchronous Sequential Logic circuits.
2. Asynchronous Sequential Logic circuits.

Course Outcomes:

After completion of the course, Student will be able to

1. Design and simulation of Combination Logic Circuit using Verilog HDL.
2. Design and simulation of Sequential Logic Circuit using Verilog HDL.
3. Design, Simulate and Extract the layouts of Analog IC Blocks using spice.
4. Analyze transient characteristics.
5. Import the logic modules into FPGA boards.

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1702EC652	COMMUNICATION AND NETWORKS LAB (Common to B.E / B.Tech – CSE, IT & ECE)	L	T	P	C
		0	0	4	2

Course Objectives:

1. To make students aware about various types of cables used in guided media like coaxial cable, optical fiber cable, twisted pair cables and its categories
2. To understand the working difference between straight cable and cross over cable.
3. To use the packet tracer to simulate various networks.

List of Experiments:

1. Study of Network Topologies
2. Implementation And Study of Stop & Wait Protocol
3. Implementation And Study of Go Back N Protocol
4. Implementation And Study of Selective Repeat Protocol
5. Configure a Network Using Distance Vector Routing Protocol
6. Configure a Network Using Link State Vector Routing Protocol
7. Implementation And Study of CSMA/CA Protocol
8. Implementation of Data Encryption And Decryption
9. Configure a Network Topology Using Packet Tracer Software
10. To Create Scenario And Study The Performance of Network With CSMA/CD Protocols through Simulation

Total: 45 Hours

Additional Experiments:

1. To Create Scenario And Study The Performance of Token Bus And Token Ring Protocols Through Simulation
2. Study of Socket Processing

Course Outcomes:

After completion of the course, Student will be able to

1. To explain how communication works in computer networks and to understand the basic terminology of computer networks.
2. To become familiar with the network simulator Packet Tracer.
3. To be able to analyze different protocols used for packet communication like ALOHA Protocol.
4. To understand the working of LAN Card, Hub, TELNET and to understand the working difference between straight cable and cross over cable.
5. To explain the role of protocols in networking and to analyze the services and features of the various layers in the protocol stack.

References:

1. Computer Networks: A Systems Approach, 4th Ed. (2007), by Larry Peterson and Bruce Davie. Covers background networking material with which students should have familiarity.
2. Computer Networking: A Top-Down Approach Featuring the Internet, 5th Ed. (2010), by James F. Kurose and Keith W. Ross. Covers similar material to Peterson and Davie.

	LIFE SKILLS: APTITUDE - II B.E – ECE	L 0	T 0	P 2	C 1

Course Objectives:

1. To brush up problem solving skill and to improve intellectual skill of the students
2. To be able to critically evaluate various real life situations by resorting to Analysis Of key issues and factors
3. To be able to demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.
4. To enhance analytical ability of students
5. To augment logical and critical thinking of Student

Unit I	**Partnership, Mixtures and Allegations, Problem on Ages, Simple Interest, Compound Interest**	**5 Hours**

Introduction Partnership - Relation between capitals, Period of investments and Shares- Problems on mixtures - Allegation rule - Problems on Allegation – Problems on ages - Definitions Simple Interest - Problems on interest and amount - Problems when rate of interest and time period are numerically equal - Definition and formula for amount in compound interest - Difference between simple interest and compound interest for 2 years on the same principle and time period.

Unit II	**Blood relations, ,Clocks, Calendars**	**5 Hours**

Defining the various relations among the members of a family - Solving Blood Relation puzzles - Solving the problems on Blood Relations using symbols and notations - Finding the angle when the time is given - Finding the time when the angle is known - Relation between Angle, Minutes and Hours - Exceptional cases in clocks - Definition of a Leap Year - Finding the number of Odd days - Framing the year code for centuries - Finding the day of any random calendar date .

Unit III	**Time and Distance, Time and Work**	**5 Hours**

Relation between speed, distance and time - Converting kmph into m/s and vice versa - Problems on average speed - Problems on relative speed - Problems on trains - Problems on boats and streams - Problems on circular tracks - Problems on races - Problems on Unitary method - Relation between Men, Days, Hours and Work - Problems on Man-Day-Hours method - Problems on alternate days - Problems on Pipes and Cisterns.

Unit IV	**Data Interpretation and Data Sufficiency**	**5 Hours**

Problems on tabular form - Problems on Line Graphs - Problems on Bar Graphs - Problems on Pie Charts - Different models in Data Sufficiency - Problems on data redundancy

Unit V	**Analytical and Critical Reasoning**	**5 Hours**

Problems on Linear arrangement - Problems on Circular arrangement - Problems on Double line-up - Problems on Selections - Problems on Comparisons - Finding the Implications for compound statements - Finding the Negations for compound statements- Problems on assumption - Problems on conclusions - Problems on inferences - Problems on strengthening and weakening of arguments .

	Total:	**30 Hours**

ASSESSMENT PATTERN :

1. Two tests will be conducted (25 * 2) - 50 marks
2. Five assignments will be conducted (5*10) - 50 Marks

Course Outcomes:

After completion of the course, Student will be able to

1. Solve problems on Partnership, Mixture & Allegation and ages least time using shortcuts and apply real life situations
2. Workout family relationships concepts, ability to visualize clocks & calendar and understand the logic behind a Sequence.
3. Calculate concepts of speed, time and distance, understand timely completion using time and work.
4. Learners should be able to understand various charts and interpreted data least time.
5. Workout puzzles, ability to arrange things in an orderly fashion.

References:

1. Arun Sharma, 'How to Prepare for Quantitative Aptitude for the CAT', 7th edition, McGraw Hills publication, 2016.
2. Arun Sharma, 'How to Prepare for Logical Reasoning for CAT', 4th edition, McGraw Hills publication, 2017.
3. R S Agarwal, 'A modern approach to Logical reasoning', revised edition, S.Chand publication, 2017.
4. R S Agarwal, 'Quantitative Aptitude for Competitive Examinations', revised edition, S.Chand publication, 2017.
5. Rajesh Verma, "Fast Track Objective Arithmetic", 3rd edition, Arihant publication, 2018.
6. B.S. Sijwalii and InduSijwali, "A New Approach to REASONING Verbal & Non-Verbal", 2nd edition, Arihnat publication, 2014.

Professional(OPEN) Elective – III

1703EC601	INFORMATION THEORY AND CODING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To know basics of Information Theory
2. To understand noiseless channel capacity
3. To have a complete understanding of network information
4. To know about source codes and its limit performance

Unit I **INFORMATION THEORY** **9 Hours**

Introduction-Measure of information- Average information content of symbols in long independent sequences-Average information content of symbols in long dependent sequences -Entropy and information rate of mark-off source.

Unit II **CAPACITY OF NOISELESS CHANNEL** **9 Hours**

Fundamental theorem for a noiseless channel,Data compression, Kraft inequality, Shannon-Fano codes , Huffman codes , Asymptotic equipartition , Rate distortion theory.

Unit III **CHANNEL CAPACITY** **9 Hours**

Channel coding theorem-Differential entropy and mutual information for continuous ensembles-Channel capacity Theorem. Binary Cycle Codes-Algebraic structures of cyclic codes

Unit IV **NETWORK INFORMATION THEORY** **9 Hours**

Gaussian multiple user channels , Multiple access channel , Encoding of correlated sources, Relay channel , Source coding and rate distortion withside information , General multi-terminalnetworks

Unit V **SOURCE CODING AND FUNDAMENTAL LIMITS ON PERFORMANCE** **9 Hours**

Encoding of the source output-Shannon's encoding algorithm-Communication Channels-Discrete communication channels -Source coding theorem-Huffman coding-Discrete memory lessChannels-Mutual information-Channel Capacity

Total: 45 Hours

Further Reading:

1. **1.** Mark-off statistical model for information source
2. **2.** Broadcast channel
3. **3.** Continuous channels

Course Outcomes:

After completion of the course, Student will be able to

1. illustrate the concept of Information theory
2. understand of noiseless channel performance
3. know different channel capacity techniques
4. recognize basics of Information theory
5. realize source coding and its limit affect performance

References:

1. Simon Haykin, Communication Systems, John Wiley & Sons. Pvt. Ltd, 2009
2. Elements of Information theory – Thomas Cover, Joy Thomas : Wiley 1999
3 Information Theory and Reliable Communication, R. G. Gallager, Wiley, 1966
4. David J.C. MacKay "Information theory, inference & learning algorithms" –Cambridge University Pres*s 2003.*
5. Taub& Schilling, Principles of Communication Systems, Tata McGraw-Hill, 2007
6. Das, Mullick&Chatterjee, Principles of Digital Communication ,Wiley Eastern Ltd,2002
7. Information Theory, Inference, and Learning Algorithms, D. J. C. MacKay, Cambridge Univ. Press, 2003

1703EC602	DIGITAL CONTROL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. Knowledge about principles of basic controllers
2. Educate the students about stability analysis of digital control systems
3. Train the students to develop digital control algorithms

Unit I **PRINCIPLES OF CONTROLLERS** **9 Hours**

Review of frequency and time response analysis and specifications of control systems, need for controllers, continues time compensations, continues time PI, PD, PID controllers, digital PID controllers

Unit II **SIGNAL PROCESSING IN DIGITAL CONTROL** **9 Hours**

Sampling, time and frequency domain description, aliasing, hold operation, mathematical model of sample and hold, zero and first order hold, factors limiting the choice of sampling rate, reconstruction

Unit III **MODELING AND ANALYSIS OF SAMPLED DATA CONTROL SYSTEM** **9 Hours**

Difference equation description, Z-transform method of description, pulse transfer function, time and frequency response of discrete time control systems, stability of digital control systems, Jury's stability test, state variable concepts, first companion, second companion, Jordan canonical models, discrete state variable models, elementary principles

Unit IV **DESIGN OF DIGITAL CONTROL ALGORITHMS** **9 Hours**

Review of principle of compensator design, Z-plane specifications, digital compensator design using frequency response plots, discrete integrator, discrete differentiator, development of digital PID controller, transfer function, design in the Z-plane

Unit V **PRACTICAL ASPECTS OF DIGITAL CONTROL ALGORITHMS** **9 Hours**

Algorithm development of PID control algorithms, software implementation, implementation using microprocessors and microcontrollers, finite word length effects, choice of data acquisition systems, microcontroller based temperature control systems, microcontroller based motor speed control systems

Total: 45 Hours

Further Reading:

Digital Control Engineering in Power electronics

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the basics of different controllers used in digital control Engineering
2. Analyze signals in both time domain and Z domain
3. Understand the basic knowledge necessary for sampled data control system
4. Understand the state variable technique
5. Develop the algorithm for digital control systems

References:

1. M.Gopal, "Digital Control and Static Variable Methods", Tata McGraw Hill, New Delhi, 1997.
2. John J. D'Azzo, "ConstantiveHoupios, Linear Control System Analysis and Design", Mc Graw Hill, 1995
3. Kenneth J. Ayala, "The 8051 Microcontroller- Architecture, Programming and applications", Penram International, 2nd Edition, 1996

1703EC603	NETWORK SECURITY (Common to B.E / B.Tech – CSE, IT& ECE)	L	T	P	C
		3	0	0	3

Course Objectives:

1. To gain knowledge on the various attacks in a network
2. To acquire knowledge on various encryption standards.
3. To build the ability to develop security standard based on the requirement

Unit I	INTRODUCTION	8 Hours

Security Threats, Security Attacks, Security Services, Mechanisms- Model for Network Security- Classical Encryption Techniques- Substitutions-Transpositions Techniques- Stream Cipher, Block Cipher-Block Cipher Modes-ECB-CBC-CFB-OFB.

Unit II	BLOCK CIPHERS AND THE DATA ENCRYPTION STANDARD	8 Hours

Simple DES-Differential cryptanalysis- DES-Modes of operation-Triple DES-AES-RC4 –RSA.

Unit III	HASH ALGORITHM, KEY MANAGEMENT	9 Hours

Hash Function-Message Digest algorithm (MD 5)- Secure Hash Algorithm- Diffie-Hellman Key Exchange- Key Management Techniques- Key Distribution- Key Agreement - Elliptic Curve Cryptography - Digital Signatures-Authentication Protocols

Unit IV	SECURITY PRACTICE & SYSTEM SECURITY	9 Hours

Authentication applications – Kerberos – X.509 Authentication services - Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology- Types of Firewalls - Firewall designs - SET for E-Commerce Transactions. Intruder – Intrusion detection system – Virus and related threats – Countermeasures – Firewalls design principles – Trusted systems – Practical implementation of cryptography and security.

Unit V	E-MAIL, IP & WEB SECURITY	11 Hours

E-mail Security: Security Services for E-mail-attacks possible through E-mail - establishing keys privacy-authentication of the source-Message Integrity-Non-repudiation-Pretty Good Privacy-S/MIME. IPSecurity: Overview of IPSec - IP and IPv6-Authentication Header-Encapsulation Security Payload (ESP)-Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding). Web Security: SSL/TLS Basic Protocol-computing the keys- client authentication-PKI as deployed by SSLAttacks fixed in v3- Exportability-Encoding-Secure Electronic Transaction (SET).

	Total:	45 Hours

Further Reading:

1. Attacks- Primarily test- factoring, Discrete Logarithms
2. Malicious software-viruses-Firewalls- Security Standards.

Course Outcomes:

After completion of the course, Student will be able to

1. Identify vulnerability of computer networks to security threats.
2. Acquire knowledge on existing security algorithms and cryptography standards.
3. Understand various cryptography techniques and their implications on network security
4. Analyze the type of security threat and the appropriate security standard to be adopted
5. Formulate and implement new security standards

References:

1. William Stallings,"Cryptography and Network Security: Principles and Practice",Prentice Hall Professional Technical Reference, Fourth Edition. 2004
2. Alfred J. Menezes, Paul C.VanOorSchot, Scott A.Van Stone, "Handbook Of Applied Cryptography", CRC Press, 1996.
3. Atul Kahate "Cryptography and Network Security". Tata McGraw-Hill
4. Bruce Schneier,"Applied Cryptography: Protocols, Algorithms, and Source Code in C",Second Edition, Wiley, John & Sons, Incorporated, October 1995.
5. Richard E. Smith,"Internet Cryptography", Addison- Wesley, 1997

1703EC604	REAL TIME OPERATING SYSTEM (Common to B.E / B.Tech – CSE, IT & ECE)	L	T	P	C
		3	0	0	3

Course Objectives:	Gain knowledge in the following:
	1. To importance of deadlines and concept of task scheduling.
	2. Student will be able to understand and design real time operating systems which are backbone of embedded industry.

Unit I	**INTRODUCTION TO REAL TIME SYSTEMS**	**8 Hours**
Issues in real time computing Structure of real time system Need for RTOS Task classes Performance measures for real time system: Properties, traditional performance measures, perform ability, cost functions and hard deadlines, and Estimating program run times. Introduction LINUX/ UNIX OS.		
Unit II	**FEATURES OF REAL TIME OPERATING SYSTEM**	**9 Hours**
Messages queues mailboxes pipes timer function events memory management Interrupt basic system design using an RT (OS design principles, interrupt routines, task structures and priority.) Current research in RTOS. Case Studies: Vx Works and Micro OS-II.		
Unit III	**EMBEDDED SYSTEMS, PROCESSOR**	**9 Hours**
Embedded into a system, Hardware units and devices in a system, software, Examples, SoC and VLSI technology, Complex System design and processors, System Design process,		
Unit IV	**UNIT-III: PROCESSES AND REAL-TIME OPERATING SYSTEMS**	**8 Hours**
Threads and Tasks: Tasks, Task States, Task and Data, Concept of Semaphores, Shared Data, Inter-process Communication, Signal Function, Semaphore Functions, Message Queue Functions, Mailbox Functions, Pipe Functions. Real-Time Operating Systems: OS Services, Process Management, Timer Functions, Event Functions, Memory Management, Device, File and I/O subsystems management, Interrupt routines.		
Unit V	**EMBEDDED SYSTEM DEVELOPMENT**	**11 Hours**
Embedded Software Development Process and Testing: Introduction to Embedded Software Development Process and Tools, Host and Target Machines, Linking and Locating Software, Getting Embedded Software into the Target System, Issues in Hardware-Software Design and Co-design, Testing on Host Machine, Simulators and Laboratory Tools.		
	Total:	**45 Hours**

Further Reading:	
	Basics of operating system; Basics of Embedded system
Course Outcomes:	
	After completion of the course, Student will be able to
	1. Understand the basics of RTOS and LINUX
	2. Handle the RTOS mail boxes, time functions
	3. Know the Embedded system design process.
	4. Operate the RTOS systems and functions.
	5. Understand the Embedded software testing and development.

REFERENCE BOOKS:

1. An Embedded Software Primer, David E. Simon Pearson Education Asia PublicationISBN-13
2. Real Time Systems, C.M. Krishna and Kang G. Shin, TMH Publication ISBN 13:
3. Embedded system: Architecture Programming and Design, Raj kamal, TMH Publication SBN 13

17CS208	SOFT COMPUTING (Common to B.E / B.Tech – ECE, CSE& IT)	L	T	P	C
		3	0	0	3

Course Objectives:

1. Learn the various soft computing frame works.
2. Be familiar with design of various neural networks.
3. Be exposed to fuzzy logic.
4. Learn genetic programming.

Unit I **INTRODUCTION** **9 Hours**

Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks-basic models - important technologies - applications. Fuzzy logic: Introduction - crisp sets- fuzzy sets - crisp relations and fuzzy relations: cartesian productof relation - classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts.

Unit II **NEURAL NETWORKS** **9 Hours**

McCulloch-Pitts neuron - linear separability - hebb network - supervised learning network: perceptron networks - adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, iterative autoassociative memory network & iterative associative memory network – unsupervised learning networks: Kohonenself organizing feature maps, LVQ – CP networks, ART network.

Unit III **FUZZY LOGIC** **9 Hours**

Membership functions: features, fuzzification, methods of membership value assignments-Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic -extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

Unit IV **GENETIC ALGORITHM** **9 Hours**

Genetic algorithm and search space - general genetic algorithm – operators - Generational cycle - stopping condition – constraints - classification - genetic programming – multilevel optimization – real life problem- advances in GA

Unit V **HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS** **9 Hours**

Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems - simplified fuzzy ARTMAP - Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers

Total: 45 Hours

Further Reading:

1. Reinforcement learning
2. Applications of neuro fuzzy system

Course Outcomes:

After completion of the course, Student will be able to

1. Apply various soft computing frame works.
2. Design of various neural networks.
3. Use fuzzy logic.
4. Apply genetic programming.
5. Discuss hybrid soft computing

References:

1. J.S.R.Jang, C.T. Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI / PearsonEducation 2004.
2. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.
3. S.Rajasekaran and G.A.VijayalakshmiPai, "Neural Networks, Fuzzy Logic and GeneticAlgorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.
4. David E. Goldberg, “Genetic Algorithm in Search Optimization and Machine Learning” Pearson Education India, 2013.
5. George J. Klir, Ute St. Clair, Bo Yuan, “Fuzzy Set Theory: Foundations and Applications”Prentice Hall, 1997.

PROFESSIONAL ELECTIVES – IV

17IT703	CLOUD COMPUTING (Common to B.E / B.Tech – CSE, IT & ECE)	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the differences between traditional deployment and cloud computing
2. To determine whether existing applications to the cloud makes technical and business sense
3. To learn how to build a transactional web application for the cloud or migrate one to it

Unit I	**Cloud Architecture Basics**	**9 Hours**

The Cloud -Hype cycle-metaphorical interpretation-cloud architecture standards and interoperability- Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public, private clouds community cloud, role of virtualization in enabling the cloud.

Unit II	**Endto End Design**	**9 Hours**

Requirement analysis: strategic alignment and architecture development cycle-strategic impact-Risk impact-financial impact-Business criteria-technical criteria-cloud opportunities –evaluation criteria and weight-End to end design-content delivery networks-capacity planning-security architecture and design.

Unit III	**Cloud Application Architectures**	**9 Hours**

Development environments for service development; Amazon, Azure, Google App-cloud platform in industry

Unit IV	**How to Move Application into the Cloud**	**9 Hours**

Web Application Design- Machine Image Design-privacy design –Database management

Unit V	**Specialized Cloud Architecture**	**9 Hours**

Workload distribution architecture-Dynamic scalability-Cloud bursting-hypervisor clustering-service quality metrics&SLA.

	Total:	**45 Hours**

Further Reading:

1. Docker and Containers
2. Server less computing

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the differences between traditional and Cloud deployment
2. Understand technical and business viability of migrating existing applications to cloud
3. Deploy cloud applications on AWS and Azure
4. Design and build cloud based applications
5. Design scalable cloud environment for elastic demands

References:

1. John Rhoton ,Cloud Computing Explained: Handbook for Enterprise Implementation 2013 edition, 2013, recursive press
2. RajkumarBuyya, Christian Vecchiola, S.ThamaraiSelvi,Mastering Cloud Computing: Foundations and Applications Programming,MorganKaufmann,,Elsevier publication, 2013
3. Thomas Erl, ZaighamMahmood, and Ricardo Puttini,Cloud Computing Concepts, Technology & Architecture, PRENTICE HALL,2013
4. Reese, G (2009). Cloud Application Architectures: Building Applications and Infrastructure in the Cloud.Sebastopol, CA: O'Reilly Media, Inc. (2009).

17CS033	INTERNET OF THINGS (Common to B.E / B.Tech – CSE, IT & ECE)	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the concepts of Internet of Things
2. To introduce network and communication protocols of IoT
3. To build IoT applications.

Unit I	Introduction to IoT	9 Hours

Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs,Machine to Machine, Difference between IoT and M2M, Software definedNetwork(SDN)

Unit II	Network and Communication Aspects	9 Hours

Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

Unit III	Challenges of IoT	9 Hours

Design challenges, Development challenges, Security challenges, Other challenges

Unit IV	Applications of IoT	9 Hours

Home automation, Industry applications, Surveillance applications, Other IoT applications

Unit V	Developing IoTs	9 Hours

Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python

Total:	45 Hours

Further Reading:

1. Cloud Computing
2. Dockers and Containers

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the concepts of Internet of Things
2. Analyze basic protocols in wireless sensor network
3. Design IoT applications in different domain and be able to analyze their performance
4. Implement basic IoT applications on embedded platform
5. Develop the coding using Python programming.

References:

1. Vijay Madisetti, ArshdeepBahga, “Internet of Things: A Hands-On Approach”
2. WaltenegusDargie,ChristianPoellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

1703EC815	BIG DATA ANALYTICS (Common to B.E / B.Tech – CSE& IT)	L	T	P	C
		3	0	0	3

Course Objectives:

1. Be exposed to big data
2. Learn the different ways of Data Analysis
3. Learn the mining and clustering
4. Be familiar with the data streams and visualization

Unit I	**INTRODUCTION TO BIG DATA**	**9 Hours**

Introduction to Big Data Platform – Challenges of conventional systems - Web data – Evolution of Analytic scalability, analytic processes and tools, Analysis vs reporting - Modern data analytic tools, Stastical concepts: Sampling distributions, resampling, statistical inference, prediction error.

Unit II	**DATA ANALYSIS**	**9 Hours**

Regression modeling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks, Support vector and kernel methods, Analysis of time series: linear systems analysis, nonlinear dynamics - Rule induction - Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, Stochastic search methods.

Unit III	**MINING DATA STREAMS**	**9 Hours**

Introduction to Streams Concepts – Stream data model and architecture - Stream Computing,Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window – Realtime Analytics Platform(RTAP) applications - case studies - real time sentiment analysis, stock market predictions.

Unit IV	**FREQUENT ITEMSETS AND CLUSTERING**	**9 Hours**

Mining Frequent itemsets - Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent itemsets in a stream – Clustering Techniques – Hierarchical – K- Means – Clustering high dimensional data – CLIQUE and PROCLUS – Frequent pattern based clustering methods – Clustering in non-euclidean space – Clustering for streams and Parallelism.

Unit V	**FRAMEWORKS AND VISUALIZATION**	**9 Hours**

MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed file systems – Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications

	Total:	**45 Hours**

Further Reading:

1. Analyzing big data with twitter
2. Big data for Ecommerce and Big data for blogs

Course Outcomes:

After completion of the course, Student will be able to

1. Apply the statistical analysis methods.
2. Compare and contrast various soft computing frameworks
3. Design distributed file systems
4. Apply Stream data model.
5. Use Visualization techniques

References:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. AnandRajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge UniversityPress, 2012.
3. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams withAdvancedanalystics, John Wiley & sons, 2012.
4. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007 Pete Warden, Big DataGlossary, O'Reilly, 2011.

1702CS601	INTRODUCTION TO WEB TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart the new concepts in Web Technologies
2. To develop understanding about the different technologies used in the World Wide Web including XML, Perl, Rails and PHP

Unit I **INTRODUCTION** **9 Hours**

XHTML Evolution of HTML and XHTML- Standard XHTML Document Structure- Basic Text Markup- Images-Hypertext Links-Lists- Tables- Forms- Frames. Cascading Style Sheets Introduction to CSS – Levels of Style Sheets- Style Specification Formats- Selector Forms- Property Value Forms – Font Properties- List Properties – Color- Alignment of Text – Background Images- Span and Div Tags.

Unit II **XML** **9Hours**

Introduction to SGML – features of XML - XML as a subset of SGML – XML Vs HTML – Views of an XML document - Syntax of XML- XML Document Structure – Namespaces- XML Schemas- simple XML documents – Different forms of markup that can occur in XML documents - Document Type declarations – Creating XML DTDs – Displaying XML Data in HTML browser – Converting XML to HTML with XSL minimalist XSL style sheets – XML applications

Unit III **PERL** **9 Hours**

Origin and Use of Perl- Scalars and their Operations – Assignment Statements and Simple Input and Output – Control Statements- Fundamentals of Arrays – Hashes References- Functions- Pattern Matching – File Input and Output – Simple programs in Perl -Using Perl for CGI Programming.

Unit IV **PHP & MySQL** **9 Hours**

Origin and Use of PHP- Overview of PHP- General Syntactic Characteristics Operations and Expressions- Control Statements- Arrays- Functions-Pattern Matching- Form Handling- Files-Cookies-Session Tracking - Database Connectivity, Simple programs in PHP and MySQL.

Unit V **RAILS & AJAX** **9 Hours**

RAILS - Overview of Rails- Document Requests- Processing Forms- Rails Application with Databases – Layouts AJAX - Ajax Overview of Ajax – Basics of Ajax – Rails with Ajax.

Total: 45 Hours

Further Reading:

Data analytics& Sever less Computing

Course Outcomes:

After completion of the course, Students will be able to

1. Develop web pages using basic HTML
2. Apply XML techniques in web design
3. Implement CGI using Perl
4. Implement PHP & MySQL database connectivity for real world applications
5. Use AJAX with Rails.

References:

1. Deitel&Deitel, Nieto, Lin, Sadhu, XML How to Program, Pearson Education ,New Delhi, 2011
2. Kogent Learning Solutions Inc, Web Technologies Black Book, Dreamtech Press, New Delhi, 2009
3. Chris Bates, Web Programming Building Internet Applications 3rd ed., Wiley India Edition, New Delhi, 2009
4. Phil Ballard, Michael Moncur, Sams Teach Yourself Ajax, JavaScript and PHP, Pearson Education ,New Delhi, 2009.
5. Achyut S Godbole , Atul Kahate, Web Technologies TCP/IP Architecture and Java Programming, 2nd ed., Tata McGraw Hill Education Private Limited, New Delhi, 2010
6. Pankaj Sharma, Introduction to Web Technology, Katson Books, New Delhi, 2008
7. Bankim Patel, Lal Bihari Barik, Introduction to Web Technology & Internet, Acme Learning Private Limited, New Delhi, 2009

	GRID COMPUTING (B.E / B.Tech – ECE)	L 3	T 0	P 0	C 3
Course Objectives:					
	1. To introduce the underlying concepts and architecture of Grid Computing				
	2. To understand the grid security and management				
	3. To introduce various grid middlewares				
Unit I	**Concepts And Architecture**				**9 Hours**
Introduction-Parallel and Distributed Computing-Cluster Computing-Grid Computing-Anatomy andPhysiology of Grid-Review of Web Services-OGSA-WSRF					
Unit II	**Grid Monitoring**				**9 Hours**
Grid Monitoring Architecture (GMA) - An Overview of Grid Monitoring Systems- GridICE– JAMM -MDS-Network Weather Service-R-GMA-Other Monitoring Systems- Gangliaand GridMon					
Unit III	**Grid Security And Resource Management**				**9 Hours**
Grid Security-A Brief Security Primer-PKI-X509 Certificates-Grid Security-GridScheduling and Resource Management-Scheduling Paradigms- Working principles ofScheduling -A Review of Condor, SGE, PBS and LSF-Grid Scheduling with QoS					
Unit IV	**Data Management And Grid Portals**				**9 Hours**
Data Management-Categories and Origins of Structured Data-Data ManagementChallenges-Architectural Approaches-Collective Data Management Services-FederationServices-Grid Portals-First-Generation Grid Portals-Second-Generation Grid Portals.					
Unit V	**Grid Middleware**				**9 Hours**
List of globally available Middlewares - Case Studies-Recent version of Globus Toolkitand gLite - Architecture, Components and Features.					
	Total:				**45 Hours**
Course Outcomes:					
	After completion of the course, Student will be able to				
	1. Understand the concepts of Grid Architecture				
	2. Understand the resource and data management of grid				
	3. Analyze the security requirements of grid				
	4. Utilize the data management and grid portals				
	5. Use the grid middlewares like globus toolkit				
References:					
1.Maozhen Li, Mark Baker, The Grid Core Technologies, John Wiley & Sons ,2005.					
2.Ian Foster & Carl Kesselman, The Grid 2 – Blueprint for a New Computing Infrastructure , Morgan Kaufman – 2004.					
3.Joshy Joseph & Craig Fellenstein, “Grid Computing”, Pearson Education 2004.					
4.Fran Berman, Geoffrey Fox, Anthony J.G. Hey, “Grid Computing: Making the Global Infrastructure a reality”, John Wiley and sons, 2000.					