B.E. COMPUTER AND COMMUNICATION ENGINEERING

Regulation 2019

OPEN ELECTIVES (OE)

(Offered by Department of Computer and Communication Engineering)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	U19CS601	Multi-Core Architecture and Programming	OE	3	3	0	0	3
2	U19CS602	Service Oriented Architecture	OE	3	3	0	0	3
3	U19CS603	Network Protocols	OE	3	3	0	0	3
4	U19CS604	Software Defined Networks	OE	3	3	0	0	3
5	U19CS605	GPU Architecture and Programming	OE	3	3	0	0	3
6	U19CS606	High Speed Networks	OE	3	3	0	0	3
7	U19CS607	Introduction to Industrial Networking	OE	3	3	0	0	3
8	U19CS608	Basics of Mobile Communication	OE	3	3	0	0	3
9	U19CS610	Introduction to Augmented Reality (AR)/Virtual Reality (VR)	OE	3	3	0	0	3
10	U19CC610	Introduction to Wireless Communication Networks	OE	3	3	0	0	3

U19CC601	MULTI - CORE ARCHITECTURE AND PROGRAMMING	L	T	P	C
		3	0	0	3

Outcomes

After completion of this course, the students will be able to

CO1	Visualize Multi-core Processors and its different architectures	K1
CO2	Express knowledge about the synchronization primitives in challenges in parallel program	K2
CO3	Observe to develop shared memory programming with OpenMP	K2
CO4	Apply distributed memory programming with MPI	K3
CO5	Illustrate parallel architecture for real time scenarios	K2

MODULE-I	**INTRODUCTION TO MULTI-CORE PROCESSORS**	**9**

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks - Symmetric and Distributed Shared Memory Architectures – Cache coherence - Performance Issues – Parallel program design.

MODULE-II	**PARALLEL PROGRAM CHALLENGES**	**9**

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

MODULE III	**SHARED MEMORY PROGRAMMING WITH OpenMP**	**9**

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs - Library functions – Handling Data and Functional Parallelism – Handling Loops - Performance Considerations.

MODULE IV	**DISTRIBUTED MEMORY PROGRAMMING WITH MPI**	**9**

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation

MODULE V	**PARALLEL PROGRAM DEVELOPMENT**	**9**

Case studies - n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

TOTAL : 45 Hours

TEXTBOOKS

1. Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan-Kauffman/Elsevier, 2011.
2. Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris", Pearson, 2011 (unit 2)

REFERENCES

1. Michael J Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw Hill, 2012.
2. William Stalling, "Computer Organization and Architecture, Designing for Performancell", Pearson Education, New Delhi, 2013.

U19CC602	SERVICE ORIENTED ARCHITECTURE	L	T	P	C
		3	0	0	3

Outcomes			
	After completion of this course, the students will be able to		
	CO1	Recall XML fundamentals and build applications based on XML	K1
	CO2	Summarize the the key principles and services of SOA to perform the service composition	K2
	CO3	Compare the different web services and WS standards	K2
	CO4	Choose web services extensions to develop solutions for real time application	K3
	CO5	Model and design a service-oriented system using architectural principles, development methods with SOA and service-related technologies systematically and effectively	K3

MODULE-I	XML	9
XML document structure – Well-formed and valid documents – DTD – XML Schema – Parsing XML using DOM, SAX – XPath – XML Transformation and XSL – Xquery		
MODULE-II	**SERVICE ORIENTED ARCHITECTURE (SOA) BASICS**	**9**
Fundamental SOA, Characteristics of SOA, Benefits of SOA , Comparing SOA with Client-Server and Distributed architectures –Principles of Service Orientation – Service layers		
MODULE III	**WEB SERVICES (WS) AND STANDARDS**	**9**
Web Services Platform – Service descriptions – WSDL – Messaging with SOAP – Service discovery – UDDI – Service-Level Interaction Patterns – Orchestration and Choreography		
MODULE IV	**WEB SERVICES EXTENSIONS**	**8**
WS-Addressing – WS-Reliable Messaging – WS-Policy – WS-Coordination – WS -Transactions – WS-Security – Examples		
MODULE V	**SERVICE ORIENTED ANALYSIS AND DESIGN**	**10**
SOA delivery strategies – Service oriented analysis – Service Modelling – Service oriented design – Standards and composition guidelines — Service design – Business process design – Case Study		
		TOTAL : 45 Hours

TEXTBOOKS

1. Thomas Erl, "Service Oriented Architecture: Concepts, Technology, and Design ", Pearson Education, 2007
2. Sandeep Chatterjee and James Webber, "Developing Enterprise Web Services: An Architect's Guide", Prentice Hall, 2004

REFERENCES

1. James McGovern, Sameer Tyagi, Michael E Stevens, Sunil Mathew, "Java Web Services Architecture", Elsevier, 2003.
2. Ron Schmelzer et al. "XML and Web Services", Pearson Education, 2002.
3. Frank P.Coyle, "XML, Web Services and the Data Revolution ", Pearson Education, 2002.
4. Newcomer, Lomow, "Understanding SOA with Web Services", Pearson Education, 2005.

U19CC603	NETWORK PROTOCOLS	L	T	P	C
		3	0	0	3

Outcomes

After completion of this course, the students will be able to

CO1	Understand the Basics of Protocols, Addressing and its Functions in Computer Networks.	K2
CO2	Identify the Different Types of IP Addressing and its Functions in the Networks.	K2
CO3	Summarize Functionalities of Internet Protocol and its Elements.	K1
CO4	Describe and Analysis the Basics of TCP Protocol Design and Operations.	K4
CO5	Identify the Different Types TCP/IP Family of Network Protocols within the Network.	K2

MODULE-I	**PROTOCOLS AND STANDARDS**	**10**

Protocols and Standards- Internet Standards-Protocol Layers-OSI Reference Model-TCP/IP Protocol Suite-Addressing: Physical, Logical, Application And Port Addressing.

MODULE-II	**IP ADDRESSING**	**8**

Address Space- Notation- Range of Addresses-Classful Addressing**-:** Classes And Blocks- Two-Level Addressing- Subnetting And Supernetting-Classless Addressing**:** Variable-Length Blocks- Two-Level Addressing- Block Allocation.

MODULE III	**INTERNET PROCOCOL**	**8**

TCP/IP Protocol Suite -Datagram-Fragmentation-Options- Checksum-Security: Packet Sniffing, Packet Modification, IP Spoofing-IP Packaging-Internet Control Message Protocol: Messages and Formats- Error Reporting-Query- Checksum- Internet Control Message Protocol Design.

MODULE IV	**TRANSMISSION CONTROL PROTOCOL**	**9**

Process To Process Communication -TCP Services –Segment -Options- Checksum-Flow Control- Error Control- TCP Timers-Connection-State Transition Diagram-Congestion Control-TCP Operation- TCP Design.

MODULE V	**TCP/IP FAMILY PROTOCOLS**	**10**

User Datagram Protocol**:** UDP Services-UDP Applications-File Transfer Protocol: Connections-Communication-Command Processing-File Transfer-Anonymous FTP-Security For FTP- Hypertext Transfer Protocol: HTTP Overview-Message Formats- HTTP Connections-Security.

TOTAL : 45 Hours

TEXTBOOKS

1. Behrouz A. Forouzan, "TCP/IP Protocol Suite", Tata McGraw Hill Publishing Company, New Delhi, 2010.
2. DOUGLAS E. COMER, "Internetworking With TCPI/IP Principles, Protocols, and Architecture",Pearson, 2015.

REFERENCES

1. Achyut S. Godbole, AtulKahate, "Data Communications and Networks",Tata McGraw Hill Publishing Company, New Delhi, 2011.
2. William Stallings "Data and Computer Communications", Pearson Prentice-Hall, New Delhi, 2011.
3. W. Richard Stevens, "TCP/IP Illustrated: The Protocols", Addison-Wesley Professional, 2011.

U19CC604	SOFTWARE DEFINED NETWORKS	L	T	P	C
		3	0	0	3

Outcomes

After completion of this course, the students will be able to

CO1	Understand the fundamentals of software defined networks.	K2
CO2	Implement the operation of SDN control plane with different controllers.	K3
CO3	Apply the use of SDN in the current networking scenario.	K3
CO4	Utilize the Interfaces and tools for SDN Programming.	K3
CO5	Design and develop various applications of SDN.	K5

MODULE-I **FUNDAMENTALS OF SOFTWARE DEFINED NETWORKS** **9**

Evolving network requirements-The SDN Approach: Requirements, SDN Architecture, Characteristics of Software-Defined Networking, SDN and NFV-Related Standards: Standards-Developing Organizations, Industry Consortia, Open Development Initiatives.

MODULE-II **OPEN FLOW & SDN CONTROLLERS** **9**

Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor-Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts.

MODULE III **DATA CENTERS** **9**

Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE.

MODULE IV **SDN PROGRAMMING** **9**

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

MODULE V **APPLICATIONS** **9**

Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring.

TOTAL : 45 Hours

TEXT BOOKS

1. William Stallings, "Foundations of Modern Networking", Pearson Ltd., 2016.
2. Paul Goransson and Chuck Black, —Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014.

REFERENCES

1. Thomas D. Nadeau, Ken Gray, —SDN: Software Defined Networks, O'Reilly Media, 2013.
2. Siamak Azodolmolky, —Software Defined Networking with Open Flow, Packet Publishing, 2013.
3. Vivek Tiwari, —SDN and Open Flow for Beginners‖, Amazon Digital Services, Inc., 2013.
4. Fei Hu, Editor, - Network Innovation through Open Flow and SDN: Principles and Design, CRC Press, 2014.

U19CC605	GPU ARCHITECTURE AND PROGRAMMING	L	T	P	C
		3	0	0	3

Outcomes

After completion of this course, the students will be able to

CO1	Identify GPU Architecture.	K3
CO2	Make use of programs using CUDA, identify issues and debug them.	K3
CO3	Experiment with efficient algorithms in GPUs for common application kernels, such as matrix multiplication	K3
CO4	Build simple programs using OpenCL	K3
CO5	Interpret efficient parallel programming patterns to solve problems	K2

MODULE-I **FUNDAMENTALS OF GPU ARCHITECTURE AND PROGRAMMING** **9**

Evolution of GPU architectures – Understanding Parallelism with GPU –Typical GPU Architecture – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA

MODULE-II **MULTI GPU AND CUDA** **9**

Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.

MODULE III **ISSUES IN PROGRAMMING CUDA** **9**

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.

MODULE IV **OPENCL** **9**

OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – OpenCL Examples.

MODULE V **ALGORITHMEMIC IMPLEMENTATION OF GPU** **9**

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster.

TOTAL : 45 Hours

TEXTBOOKS

1. Shane Cook, CUDA Programming: —A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, —Heterogeneous computing with OpenCL, 3rd Edition, Morgan Kauffman, 2015.

REFERENCES

1. Nicholas Wilt, —CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison – Wesley, 2013.
2. Jason Sanders, Edward Kandrot, —CUDA by Example: An Introduction to General Purpose GPU Programming, Addison – Wesley, 2010.
3. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors – A Hands-on Approach, Third Edition, Morgan Kaufmann, 2016.

U19 CC 606	HIGH SPEED NETWORKS	L	T	P	C
		3	0	0	3

Outcomes			
	After completion of this course, the students will be able to		
	CO1	Understand the Basics of Architecture of ATM and High Speed LANs.	K2
	CO2	Able to Understand and Analyse the Congestion Control in Various Scenarios within the Packet Switching Networks.	K2
	CO3	Describe and Analysis the a Range of Traffic Managements In ATM.	K4
	CO4	Explain the Basic Taxonomy in High Speed Wireless LANs and Architecture Implementation.	K2
	CO5	Compare and Select Appropriate Modes in Wireless ATM Networks.	K4

MODULE-I	HIGH SPEED NETWORKS	9

Asynchronous Transfer Mode – ATM Protocol Architecture, ATM Logical Connection – ATM Cell – ATM Service Categories – AAL. High Speed LANs – Fast Ethernet – Gigabit Ethernet – Fibre Channel – Wireless LAN's Applications, Requirements – Architecture Of IEEE 802.11.

MODULE-II	QUEUING ANALYSIS AND CONGESTION CONTROL	9

Single Server Queues – Multiserver Queues – Queues with Priorities – Networks of Queues –Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control.

MODULE III	ATM CONGESTION CONTROL	9

Traffic and Congestion Control in ATM – Requirements – Attributes – Traffic Management Frame Work – Traffic Control – ABR Traffic Management – ABR Rate Control – RM Cell Formats – ABR Capacity Allocations – GFR Traffic Management.

MODULE IV	HIGH SPEED WIRELESS LAN	8

Classification Of Wireless LANs: Radio LANs-Direct Sequence Spread Spectrum-Frequency Hopping Spread Spectrum-Comparison-Infrared LANs-Wireless LAN Implementation-Components-Protocol Architecture-LAN Topologies-Deployment- Performance Of Wireless LANs.

MODULE V	WIRELESS ATM Networks	10

ATM Technology: Comparison of Transfer Modes, ATM vs IP- Need for Wireless ATM-Wireless Communication using ATM-Multimedia Communications using Wireless ATM.

TOTAL : 45 Hours

TEXTBOOKS

1	William Stallings, "High-speed Networks and Internet", Pearson Education, 2nd Edition, 2002.
2	Benny Bing, "High-Speed Wireless ATM and LANs",Artech House Publishers, 2000.

REFERENCES

1	Jean Warland, PravinVaraiya, "High-performance Communication Networks", Jean Harcourt Asia Private Limited, 2nd Edition, 2000.
2	Abhijit S. Pandya, ErcanSen, "ATM Technology for Broadband Telecommunications Networks", CRC Press, 2004.
3	William Stallings, "High-speed Networks: TCP/IP and ATM Design Principles", PHI, 2nd Edition, 2008.

U19CC607	INTRODUCTION TO INDUSTRIAL NETWORKING	L	T	P	C
		3	0	0	3

Outcomes

After completion of this course, the students will be able to

CO1	Understand the basic concepts of data networks	K2
CO2	Familiarise the basics of inter networking and serial communications	K3
CO3	Understand the details on HART and Field buses	K2
CO4	Understand on MODBUS, PROFIBUS and other communication protocol	K2
CO5	Understand the industrial Ethernet and wireless communication	K2

MODULE-I DATA NETWORK FUNDAMENTALS **9**

Networks hierarchy and switching – Open System Interconnection model of ISO - Data link control protocol - Media access protocol - Command / response - Token passing - CSMA/CD, TCP/IP

MODULE-II INTERNET WORKING and RS 232, RS 485 **9**

Bridges - Routers - Gateways - Standard ETHERNET and ARCNET configuration special requirement for networks used for control - RS 232, RS 485 configuration Actuator Sensor (AS) – interface, Devicenet

MODULE III HART AND FIELDBUS **9**

Introduction - Evolution of signal standard - HART communication protocol - HART networks - HART commands - HART applications - Field bus - Introduction - General Field bus architecture - Basic requirements of Field bus standard - Field bus topology - Interoperability - Interchangeability - Introduction to OLE for process control (OPC).

MODULE IV MODBUS AND PROFIBUS PA/DP/FMS AND FF **9**

MODBUS protocol structure - function codes – troubleshooting Profibus, Introduction, Profibus protocol stack, Profibus communication model - communication objects - system operation - troubleshooting - review of foundation field bus - Data Highway

MODULE V INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION **9**

Industrial Ethernet, Introduction, 10 Mbps Ethernet, 100 Mbps Ethernet - Radio and wireless communication, Introduction, components of radio link - radio spectrum and frequency allocation - radio MODEMs-Introduction to wireless HART and ISA100.

TOTAL : 45 Hours

TEXTBOOKS

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial Data Networks Design, Installation and Troubleshooting' Newnes Publication, Elsevier First Edition, 2004
2. A. Behrouz Forouzan, Data Communications & Networking ,3RD edition, Tata Mc Graw hill,2006.

REFERENCES

1. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Prentice Hall of India Pvt. Ltd., 5th Edition. 2011.
2. Theodore S Rappaport, Wireless Communication: Principles and Practice, Prentice Hall of India 2nd Edition, 2001.
3. William Stallings, Wireless Communication & Networks, Prentice Hall of India, 2nd Edition, 2005.

U19CC608	BASICS OF MOBILE COMMUNICATION	L	T	P	C
		3	0	0	3

Outcomes			
	After completion of this course, the students will be able to		
	CO1	**(Understand)** Understand the wireless communication and medium used for cellular systems.	K2
	CO2	**(Understand)** Understand the basics of mobile telecommunication system and the architecture	K2
	CO3	**(Understand)** Understand the architecture of Wireless LAN technologies	K2
	CO4	**(Understand)** Determine the functionality of network layer and transport layer and illustrate the generations of wireless networks	K2
	CO5	**(Understand)** Know the functionalities of application layer and associated languages and operating system in mobile communications	K2

MODULE-I	WIRELESS TRANSMISSION AND CHANNEL	9

Introduction: Applications, History of wireless communication. Wireless Transmission: Frequencies for radio transmission, Signal Propagation, Cellular Systems. Medium Access Control: Motivation for a specialized MAC, SDMA, FDMA, TDMA and CDMA.

MODULE-II	MOBILE COMMUNICATION SYSTEMS	9

Mobile Communication systems: GSM Mobile services, System Architecture, Radio Interface, Protocols, Localization and calling, Handover, Security, New Data services. Satellite systems: Overview and applications. Broadcast systems: Overview, DAB and DVB, Convergence of Broadcasting and Mobile communication.

MODULE III	WIRELESS LAN	8

Wireless LAN: Infra red vs. radio transmission, Infrastructure and ad-hoc network, IEEE 802.11, HIPERLAN, Bluetooth.

MODULE IV	MOBILE NETWORK LAYER AND TRANSPORT LAYER	9

Mobile Network Layer and Transport Layer: Mobile IP, Dynamic Host Configuration Protocol, Mobile ad-hoc networks, Traditional and classical TCP and TCP over 2.5/3G wireless networks.

MODULE V	APPLICATION LAYER	10

Application Layer: Wireless Application Protocol, Architecture, Wireless datagram protocol, wireless transport layer security, wireless transaction protocol, wireless session protocol, wireless application environment, wireless mark-up language, WMLScript, I-mode, SuncML, WAP2.0, Mobile Application Languages: Mobile application Development, XML, JAVA, Java 2 Micro Edition, Java card, Mobile Operating system: Window Mobile and CE, Android.

TOTAL : 45 Hours

TEXTBOOKS

1	Jochen Schiller, "Mobile communications" Pearson, 2nd edition 2009
2	Clint Smith, Daniel Collins, "Wireless Networks", Third Edition, McGraw Hill Publications, 2014.

REFERENCES

1	Raj Kamal, "Mobile Computing" Ocford University Press 2nd Edition
2	Prasanth Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt.Ltd., New Delhi, 2012

U19CS610	INTRODUCTION TO AUGMENTED REALITY (AR)/ VIRTUAL REALITY (VR)	L	T	P	C
		3	0	0	3

Outcomes

After completion of this course, the students will be able to

CO1	**(Apply)** Identify the fundamentals of Augmented/Virtual Reality.	K3
CO2	**(Apply)** Categorize the hardware requirements for 3-Dimension.	K3
CO3	**(Analyze)** Classify the Software technologies used in 3 and 2 Dimension.	K4
CO4	**(Analyze)** Dissect the Interaction techniques used in VR.	K4
CO5	**(Apply)** Organize the AR/VR Applications used in real-world.	K3

MODULE-I **FUNDAMENTALS OF ARITIFICIAL AND VIRTUAL REALITY** **8**

The historical development of VR: Scientific landmarks Computer Graphics, Real-time computer graphics, Flight simulation, Virtual environments, Requirements for VR, benefits of Virtual reality.

MODULE-II **3D USER INTERFACE INPUT HARDWARE** **9**

HARDWARE TECHNOLOGIES: Visual Displays Auditory Displays, Haptic Displays. Input device characteristics, Desktop input devices, Tracking Devices, 3D Mice, Special Purpose Input Devices, Direct Human Input, Home - Brewed Input Devices, Choosing Input Devices for 3D Interfaces.

MODULE III **SOFTWARE TECHNOLOGIES** **10**

Database - World Space, World Coordinate, World Environment, Objects - Geometry, Position / Orientation, Hierarchy, Bounding Volume, Scripts and other attributes, VR Environment - VR Database, Tessellated Data, LODs, Cullers and Occluders, Lights and Cameras, Scripts, Interaction - Simple, Feedback, Graphical User Interface, Control Panel, 2D Controls.

MODULE IV **3D INTERACTION TECHNIQUES** **10**

3D Manipulation tasks, Manipulation Techniques and Input Devices, Interaction Techniques for 3D Manipulation, Deign Guidelines - 3D Travel Tasks, Travel Techniques, Design Guidelines - Theoretical Foundations of Wayfinding, User Centered Wayfinding Support, Environment Centered Wayfinding Support, Evaluating Wayfinding Aids, Design Guidelines - System Control, Classification, Graphical Menus, Voice Commands, Gestrual Commands, Tools, Mutimodal System Control Techniques, Design Guidelines.

MODULE V **VIRTUAL REALITY APPLICATIONS** **8**

DESIGNING AND DEVELOPING 3D USER INTERFACES: Strategies for Designing and Developing Guidelines and Evaluation. Engineering, Architecture, Education, Medicine, Entertainment, Science, Training

TOTAL : 45 Hours

TEXTBOOK:

1. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.

REFERENCES

1. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
3. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
4. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Inderscience, India, 2003.

Leadership & Excellence