MS Program in Networking and Telecommunications

Course Structure

	Code	Course Name	Credits*
BRIDGE	AST 001	Computer Architecture and Operating Systems	
	ESD 002	Signals and Systems	
	NTC 001	Communication Systems	
	NTC 002	Computer Networks	
FOUNDATION	NTC 501	Programming Methodologies	3
	NTC 502	Network Technologies and Protocols	4
	NTC 503	Routing Algorithms and Protocols	3
	AST 509	Introduction to Database Design	2
	NTC 504	Server Administration and Management	3
	NTC 505	Seminar – I	1
CORE	NTC 601	Wireless Communications	3
	NTC 602	Optical Networks	3
	NTC 603	Network Management and Security	3
	NTC 604	Network Programming	3
	AST 603	Software Engineering and Project Management	2
	NTC 605	Seminar – II	1
ADVANCED	NTC 701	Multimedia Technologies	3
	NTC 702	Broadband Technologies	3
	NTC 703	Protocol Architecture and Applications	3
	NTC 704	Next Generation Networks	3
ELECTIVES	Elective – 1 (Select any ONE)		3
	NTC 811	Network Engineering	
	NTC 812	Telecom Switching and Traffic Engineering	
	ESD 503	Digital Signal Processing	
	Elective - 2 (Select any TWO)		3 each
	NTC 821	Advanced Network Management and Security	
	NTC 822	Storage Area Networks	
	NTC 823	Multiple Play Services	
	NTC 824	OSS and BSS	
	NTC 825	Telecom Software Development	
	NTC 826	Embedded Software Design for Networking and Telecom	
PROJECT	NTC 901	Mini Project	2
	NTC 902	Project	18

* 1 Credit Hr = 16 Class Hrs / 32 Lab Hrs in a semester.

MS Program in Wireless Technologies

" There were more than 2 billion mobile phone users in 2005, and it is possible to foresee that 3 billion users will be reached by 2009."
- Yoshio Utsumi,
Secretary General, International Telecom Union (ITU) in ITU Telecom World 2006

Wireless networks are rapidly becoming a part of our everyday life. The widespread availability of miniature wireless devices such as PDAs, cellular phones, pocket PCs, and sensors are one step towards making the vision of anywhere, anytime pervasive access and computing a reality. Cellular 2G/3G networks are true examples of such mobile communication systems. Convergence is redefining the boundaries of data, voice and video services. Wireless network systems designed to GSM and IS-95 standards have been deployed worldwide in the past decade for providing value-added applications and services on these systems. The evolution of 2G technologies to 3G and 4G poses interesting technological and business challenges, as the deployment of broadband networks grows aggressively. As multiple technologies such as Bluetooth, WiFi, WiMax are deployed, service providers are focusing on revenue enhancement opportunities by offering 'Triple Play' (data, voice and video) and other applications over broadband wired and wireless networks. The great success of the Internet and wireless communications has opened a new vista for future all-IP wireless applications, driven by increasing demand for packet data services in worldwide 2.5G and 3G networks. It has been envisioned that the future wireless systems will be operating based mainly on burst data services carrying multimedia contents, including voice, data, image and video. Such increasing demand for multimedia communication drives the development of consumer and enterprise markets as well as the evolution of wireless technologies. The support of multimedia is believed to be one of the pre-requisites to guarantee the success of the next generation wireless networks. But we are still a long way off from the goal of seamless wireless operation where any wireless device would be able to connect to any other wireline/wireless device at any time, in any place, and while satisfying the requirements of the user. Recently, mobile adhoc networks, sensor networks and mesh networks are emerging as three typical multi-hop networks. Technology under development for wireless networks is making important steps toward this goal. This MS Program in Wireless Technologies is designed to prepare the students to handle such challenges in the fastest growing wireless industry. The program provides comprehensive, theoretical, practical and real life knowledge of advanced wireless technologies as demanded by the industry today and for the future.

Program

This autonomous, four semester, 24-month, 72 Credits, full-time Masters Program in Wireless Technologies is designed to equip students with the knowledge for design, development and planning in the field of Wireless Technologies. The major focus of the program includes the areas:
- Wireless Networking Technologies
- Wireless Network Management and Security
- Wireless Application Development
- Wireless Network Planning, Design, and Optimization
- Next Generation Wireless Networks

Program Structure

- Successful completion requires 72 Credits.
- To bridge the gap between theory and practice, project work worth 18 Credits in the last semester.
- The entire curriculum is distributed over six levels to aim at transcending the students' level of understanding for corporate readiness. The levels are respectively, Bridge, Foundation, Core, Advanced, Electives and Project.
- As an option to the advanced courses of this program, a student can take total 9 Credits courses from any other suitable MSP / MBAP program provided they are fit for such courses.
- Students have to carry out one mini project in specified semester to consolidate the technical knowledge in the selected specialization stream.
- Students are required to take three electives during the program
- To be eligible for MSP in Wireless Technologies, a student has to take minimum subjects worth 63 Credits from this stream out of 72 Credits.

Program Pedagogy

All courses are designed to address the key areas like theoretical foundation, practical relevance and the real life problem solving approach. To achieve that courses will be delivered using collaborative learning process through class room lectures, laboratory sessions, assignments, student seminars, lectures by industry experts, case studies, relevant industry visits and research / industry projects.

Distinctive Features

- Theory and laboratory sessions to gain experience of practical situations in carrier class networks and convergence technologies
- Working with the state-of-the-art wireless, networking, and telecom hardware and software tools in the laboratories
- Expert lectures, seminars and case studies by leading experts from industries
- An option to work on projects that require working with faculty members and students from other streams such as advanced software technologies, embedded systems, VLSI and ICT business management

Eligibility

- Graduates with a Bachelor's Degree in Engineering / Technology (with minimum 50 percent marks) of at least four years' duration in Electronics / Communication /

Computer Science or equivalent

↘Basic knowledge of Radio Communication, Data Communication, and Networking

↘Programming background in C and C++ is desirable

Program Commencement

The program commences in July / October.

Evaluation and Certification

↘Continuous evaluation and performance improvement program

↘Course-wise Credits

↘Balanced assessment based on internals, mid-term test, laboratory and final theory examinations and project

↘Detailed transcripts along with certificate

Placement Assistance

↘Career guidance at the institute

↘Pre-placement facilitation/development and Campus Interview by leading Industries

↘Active interface with Technology and user companies

Selection Process

The selection of an applicant for the course is based on the following:

↘Application forms shall be scrutinized for academic profile in line with the eligibility criteria.

↘Score received at the Graduation level.

↘Scores received at the 'Accepted Qualifying Examinations' like GRE / GMAT / XAT / CAT / GATE and Performance in the Entrance Test

↘Personal Interview

Basic Courses

COM 001: LIFE SKILLS DEVELOPMENT
This basic course prepares students for the rigors of the master's level program and professional careers that will follow. The course is divided into 9 sections that will be conducted throughout the program. The course stresses on: communication and presentation, leadership development, working in teams, time management, negotiation skills, stress management through yoga, multicultural and diversity management and offsite experiential learning. The ultimate objective of this course is to develop individuals with high Intelligence, Emotional and Spiritual Quotients (IQ, EQ and SQ).

COM002: FOREIGN LANGUAGE (Level 1)
In order to equip students to take up global careers, a choice of foreign languages as a major subject is offered. Medium of instruction is English.

Bridge Courses

↘Keeping in view the diverse background of students, variety of courses is offered under bridge courses to attain the requisite level of competency for further learning.

↘Students will undergo entrance examination and interview as part of selection process. Depending on the performance, students will be advised to undergo the bridge courses.

↘Duration of the bridge courses is three weeks prior to the beginning of the academic term.

↘Performance in the bridge course count towards appropriate weightage in relevant foundation courses.

AST001: COMPUTER ARCHITECTURE AND OPERATING SYSTEMS
This course covers operating system design concepts with examples from Linux and windows operating system. It also focuses on the study of the hardware structure of computer systems and sub-systems. The topics in operating system include: operating system structures process and thread management, memory management virtual memory, file systems, I/O subsystem and device communication, introduction to Linux commands and shell scripts knowledge of a Linux text editor, protection and security management. The topics in computer architecture include: processor architecture, parallelism and pipelining, cache and memory organization, I/O controllers and interconnection structures.

ESD002: SIGNALS AND SYSTEMS
This course deals with the representation of signals and systems, system properties, mathematical models of continuous-time and discrete-time signals and systems, time-domain and frequency domain concepts, transfer functions and frequency response, convolution, stability, Fourier series and Fourier transform, Filtering, applications to signal processing and communication systems.

NTC001: COMMUNICATION SYSTEMS
This course refreshes the knowledge related to the communication technologies. It covers fundamentals of communication systems, continuous and pulse analog modulation techniques, sampling process, digital encoding techniques such as PCM, DPCM, DM, ADM, Vocoders, LPC, CW digital communication techniques such as BPSK, QPSK, source coding, line coding, channel coding, Shanons-Hartley theorem, radio wave propagation.

NTC002: COMPUTER NETWORKS
This course shall emphasis on developing an understanding of the underlying principles of computer networking. Students will learn fundamental concepts of communication protocol stacks: OSI and TCP/IP, IP addressing schemes, subneting, LAN, MAN, WAN fundamentals, circuit and packets switching, multiplexing, networking devices, network protocols, standards, Internet, Intranet, network security and allied technologies.

Foundation Courses

NTC501: PROGRAMMING METHODOLOGIES (3 Credits, T=2 L=1)
This course focuses on fundamental concepts of programming languages extensively required in the field of networking and telecommunications. It covers programming basic building blocks like analysis and design of algorithm, top - down - bottom up programming approaches, effective programming techniques considering factors like performance, security etc, and debugging techniques. Concepts of data structures, object oriented programming,, unified modeling language, rapid application development frameworks, C and C++ programming is also taught in the course. Several programming assignments will be given so as to acquire the necessary programming skills.

WLT501: SWITCHING AND ROUTING TECHNOLOGIES (3 Credits, T=2 L=1)
This course provides an understanding of local area networks as well as internetworking technologies and the associated protocols. It includes study of Ethernet, gigabit Ethernet, token ring, switching and bridging concepts, VLANs, Introduction of Internet, transport and application layer protocols/services such as IPv4, IPv6, ICMP, IGMP, TCP/UDP, ARP/RARP, NAT, DHCP, DNS, BOOTP, FTP, TFTP, Telnet. Concepts of advanced IP addressing, VLSM and CIDR is also taught. The subject also focuses on the concepts of IP routing and the overview of protocols used. The topics covered are study of static and dynamic routing algorithms, introduction to interior gateway protocols such as RIP and OSPF, introduction to exterior gateway protocol such as BGP, route redistribution, route filtering and mapping, and access lists.

WLT502: CODING TECHNIQUES (3 Credits, T=2 L=1)
This course focuses on various coding techniques used in communication systems with special reference to wireless technologies. It covers information coding theory, channel capacity, source encoding, Huffman coding, Shannon-Fano coding; line coding techniques; channel coding, FEC techniques, block codes, Hamming, BCH, Reed Solomon, convolutional, turbo codes, Viterbi algorithm; vocoders, linear predictive coders, codecs for wireless networks

WLT503: NTENNA AND RADIO WAVE PROPAGATION (2 Credits, T=1 L=1)
This course covers fundamentals of antenna systems, related terminologies and characteristics, relationship between physical properties and electrical performance of various types of antennas, wire and loop antennas, antenna arrays, broadband antennas, frequency independent antennas, reflector, horn, and aperture antennas, propagation channel considerations such as multi path fading, RF path loss, noise and interference, antenna systems used for wireless base stations, satellite communications, wireless handsets, RFIDs; antenna design issues, smart antennas, multi input multi output antenna systems, antenna diversity techniques and allied topics

AST509: INTRODUCTION TO DATABASE DESIGN (2 Credits, T=1 L=1)
This course focuses on the introduction to database technologies used in networking and telecom environments, with emphasis on the various aspects of database design with respect to relational modeling, normalization and object oriented relational approach. The practical implementations are to be delivered in Oracle10g. The course also introduces the differences among various database architectures like host based, client Server and distributed.

WLT504: LINUX PROGRAMMING LABORATORY (1 Credit, L=1)
This laboratory provides an understanding and experimentation on the Linux kernel architecture, file system, shell programming, GCC and IDEs, concepts of Linux device drivers.

WLT505: SEMINAR - I (1 Credit)
Students are required to deliver seminars on topics relevant to the wireless technologies domain to campus wide audience.

Core Courses

WLT601: CELLULAR NETWORKS (4 Credits, T=3 L=1)
This course begins with the fundamentals of wireless communication, multiple access techniques, study on radio propagation and loss models, fading channels, spread spectrum techniques, cellular concepts, cellular mobile telephone architecture, frequency assignment and channel reusability, access algorithms to the shared control channel, mobility and handover. In the latter part, the course focuses on the detailed study of 2G technologies such as GSM and IS-95 cdmaOne and discusses on their architecture, operations, frequency and channels allocations, signal flows, physical and logical channels, codecs used, protocol stacks, call management, radio resource management and mobility management, handover and related topics.

WLT602: WLAN TECHNOLOGIES (3 Credits, T=2 L=1)
This course provides an in-depth knowledge of various wireless networking technologies related to personal, local and metropolitan area networks. It begins with a study of different wireless standards such as IEEE802.15.1 (Bluetooth), IEEE802.15.4 (Zigbee), IEEE802.11 (Wi-Fi) etc., its architecture, required hardware equipments and network elements. A comprehensive coverage on topics like 802.11 frames type and formats, different physical layer transmission techniques, channel access and allocation, media access techniques-contention based and contention free access, multi-rate transmission support, device addressing and identification mechanisms, mobility and hand-off, mobile IP, Quality of Service, performance measurement, WLAN security issues: a detailed study on different security algorithms WEP, TKIP, CMIC, WPA, 802.1X frame work. Wireless Network Design and Deployment issues, introduction to mesh topology and its advantages. In the latter part, the course focuses on the IEEE802.16 (WiMax) standards and allied topics.

WLT603: 2.5/3G WIRELESS NETWORKS (3 Credits, T=2 L=1)
The course emphasizes on the evolution of wireless technologies and networks from 2G and as defined by the standards IMT2000. The course begins with the study of evolution of wireless technologies and the demand of higher data rates and applications. It covers the study of technologies evolving from GSM such as GPRS, EDGE, UMTS, HSDPA; and the technologies evolving from cdmaOne such as 1xRTT, 1xEVDO, 1xEVDV, CDMA2000. The discussion emphasizes on architectures, operations, frequency and channels allocations, physical and logical channels, protocol stacks, call management, radio resource management and mobility management, handover and related topics.

NTC604: NETWORK PROGRAMMING (3 Credits, T=2 L=1)
This course mainly focuses on communication protocols such as TCP/IP, XNS, UUCP and then covers various aspects of socket programming for TCP and UDP, implementation of iterative and concurrent servers, overview of the concept of network communication like TFTP, remote command execution, rlogin and inter process communication. This course includes classroom teaching followed by Lab with an intention of getting strong theoretical foundation as well as hands on experience on creating and using sockets. After the completion of this course, students will be able to implement vital networking applications in conformity with their respective RFC specifications.

MS Program in Wireless Technologies

Course Structure

	Code	Course Name	Credits*
BRIDGE	AST 001	Computer Architecture and Operating Systems	
	ESD 002	Signals and Systems	
	NTC 001	Communication Systems	
	NTC 002	Computer Networks	
FOUNDATION	NTC 501	Programming Methodologies	3
	WLT 501	Switching and Routing Technologies	3
	WLT 502	Coding Techniques	3
	WLT 503	Antenna and Radio Wave Propagation	2
	AST509	Introduction to Database Design	2
	WLT 504	Linux Programming Laboratory	1
	WLT 505	Seminar – I	1
CORE	WLT 601	Cellular Networks	4
	WLT 602	WLAN Technologies	3
	WLT 603	2.5/3G Wireless Networks	3
	NTC 604	Network Programming	3
	AST 603	Software Engineering and Project Management	2
	WLT 605	Seminar – II	1
ADVANCED	NTC 701	Multimedia Technologies	3
	WLT 701	Wireless Network Management and Security	3
	WLT 702	MANETs and Sensor Area Networks	3
	NTC 704	Next Generation Networks	3
ELECTIVES	Elective – I (Select any ONE)		3
	ESD 503	Digital Signal Processing	
	WLT 811	Wireless Network Planning and Optimization	
ELECTIVES	Elective – II (Select any TWO)		3 each
	NTC 702	Broadband Technologies	
	WLT 821	Performance Evaluation of Wireless Networks	
	WLT 822	Wireless Application Development	
	NTC 823	Multiple Play Services	
	NTC 824	OSS and BSS	
	NTC 826	Embedded Software Design for Networking and Telecom	
PROJECT	WLT 901	Mini Project	2
	WLT 902	Project	18

* 1 Credit Hr = 16 Class Hrs / 32 Lab Hrs in a semester.

MS Program in Embedded Systems Design

"Everything will be connected, and I mean literally everything. Not just electronic devices, but everything down to your piano. We'll have as many as four or five (embedded) Internet devices on our bodies."

- John Chambers

Recent developments in embedded systems are spanning new applications in computing, communications, networking, automotive electronics, medical electronics, avionics and the like. A three-dimensional growth is taking place in this high-end technology sector, with increasingly powerful micro-controllers and digital signal processors competing with emerging tools in Field Programmable Gate Arrays (FPGAs). Embedded systems range in size from pacemakers, and intelligent sensors, to cell phones and PDAs, to stand alone and distributed elements like set top boxes, modems, network elements and to large-scale systems deployed in process control, manufacturing, power generation, defense applications, telecommunications, automotive electronics, air traffic control, video-on-demand and video-conferencing. Embedded systems actually account for more than 90 percent of the manufactured processors. India is emerging as a global embedded design and software destination due to its cost advantages and emerging talent pool in this domain. Demand is continuing to outstrip the availability of highly skilled pool of graduates for the fast evolving embedded systems industry. This program introduces students both, to the state-of-the-art and state-of-the-practice in the broad field of embedded and real-time computing, control, and communication and enables them to pursue rewarding careers in these frontier areas of technology.

Program

This autonomous four-semester, 24-month, 72 credit full-time Masters Program in Embedded Systems Design is designed to equip the students to gain industry oriented technical knowledge and also imparts hardcore skills in the high-end technologies related to embedded systems. This curriculum starts with introductory concepts in hardware and software, and incorporates an essential knowledge base of hardware and software co-design along with application specific embedded design concepts. Nearly one third of learning happens through hands on practice.

Program Structure

- 72 Credits required for successful completion.
- Project work of 18 Credits incorporated in the last trimester to bridge the gap between theory and practice.
- Curriculum categorized into six levels of increasing complexity and corporate readiness: Basic, Foundation, Core, Advanced, Electives and Project.
- As an option to the advanced courses of this program, a student can take total 9 Credits courses from any other suitable MS Program provided they are fit for such courses.
- The student has to carry out at least one mini project in the specified trimester to consolidate the technical knowledge in

selected specialization stream.
- Students are required to take four electives from the elective courses listed.
- To be eligible for MSP-ESD, a student has to take minimum subjects worth 63 Credits from this program out of 72 Credits.

Program Pedagogy

All courses are designed to address the key areas of theoretical foundation, practical relevance and real life problem solving approach. To achieve this, the courses will be delivered by the use of collaborative learning processes through class room lectures, laboratory sessions, assignments, student seminars, and lectures by industry experts, case studies, relevant industry visits and research / industry projects.

Distinctive Features

- Exposure to state-of-the-art micro-controllers, digital signal processors and programmable logic arrays in the laboratories
- Coverage of all the above three embedded system domains
- Development experience in real environment.
- Application specific course design
- Flexibility in the choice of project domain
- A choice of research or industry project

Eligibility

Graduates with recognized Bachelors Degree of Engineering in Electrical / Instrumentation / Electronics / Communication / Information Technology / Computer Science/ M.Sc. in Electronics or equivalent with at least 50% marks at the graduation level. Proficiency in C, C++ and Java is desired.

Program Commencement

The program commences in July / October.

Selection Process

The selection of an applicant for the course is based on the following:
- Application forms shall be scrutinized for academic profile in line with the eligibility criteria.
- Scores received at the Graduation level like BE / BTech, M.Sc (Electronics) or equivalent.
- Scores received at the qualifying examinations like GRE / GATE & performance in the Entrance Test.
- Personal interview.

Evaluation and Certification

- Continuous evaluation and performance improvement program. Course-wise Credits.
- Balanced assessment based on internals,