

## B.Sc. in Network Engineering and Security

### Study Plan

#### ■ University Compulsory Courses 16 C.H

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#### ■ University Elective Courses 9 C.H

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#### ■ Faculty Compulsory Courses 27 C.H

Line No.	Code	Course	
901010	MATH101	CALCULUS( 1)	3
901020	MATH102	CALCULUS (2)	3
1712310	CPE231	DIGITAL LOGIC DESIGN	3
1731011	CS101	INTRODUCTION TO PROGRAMMING	3
1731020	CS102	PROGRAMMING LAB	1
1731121	CS112	INTRODUCTION TO OBJECT-ORIENTED PROGRAMMING	3
1732111	CS211	DATA STRUCTURES AND ALGORITHMS	3
1742000	CI5200	PROFESSIONAL AND ETHICAL ISSUES IN COMPUTING	1
1742010	CI5201	INTRODUCTION TO WEB DESIGN	1
1742011	CI5201	INTRODUCTION TO WEB DESIGN (LAB)	0
1742280	CI5228	FUNDAMENTALS OF DATABASE SYSTEMS	3
1762300	SE230	FUNDAMENTALS OF SOFTWARE ENGINEERING	3

#### ■ Department Compulsory Courses 96 C.H

Line No.	Code	Course	
242120	EE212	ELECTRICAL CIRCUITS (FOR NON MAJOR)	3
242130	EE213	ELECTRICAL CIRCUITS LAB	1
242601	EE260	SIGNAL AND SYSTEM ANALYSIS	3
243211	EE321	ELECTRONICS (1) (FOR NONE EE STUDENTS)	3
243220	EE322	ELECTRONIC CIRCUITS LAB (2)	1
252000	ME200	ENGINEERING DRAWING (A)	1
252150	ME215	ENGINEERING MECHANICS	3
902030	MATH203	ORDINARY DIFFERENTIAL EQUATIONS	3
902411	MATH241A	DISCRETE MATHEMATICS	3
921010	PHY101	GENERAL PHYSICS (1)	3
921020	PHY102	GENERAL PHYSICS (2)	3
1712330	CPE233	DIGITAL LOGIC DESIGN LAB	1
1712520	CPE252	COMPUTER ORGANIZATION AND DESIGN	3
1713520	CPE352	COMPUTER ARCHITECTURE	3
1713530	CPE353	MICROPROCESSOR SYSTEMS (Non CPE students)	3
1714700	CPE470	OPERATING SYSTEMS	3
1752010	NES201	COMMUNICATION SKILLS	3
1752020	NES202	INTRODUCTION TO UNIX	3
1753010	NES301	PROBABILITY AND QUEUEING THEORY	3
1753110	NES311	DATA COMMUNICATION	3

1753120	NES312	FUNDAMENTALS OF COMPUTER NETWORKS	3
1753900	NES390	PRACTICAL TRAINING (1)	2
1754110	NES411	NETWORK PROGRAMMING	3
1754120	NES412	NETWORK SIMULATION AND MODELING	3
1754130	NES413	COMPUTER NETWORKS LABORATORY	1
1754150	NES415	NETWORKING PROTOCOLS	3
1754400	NES440	WIRELESS NETWORKS	3
1754510	NES451	BASICS OF INFORMATION SYSTEM SECURITY	3
1754520	NES452	CRYPTOGRAPHY AND NETWORK SECURITY	3
1754600	NES460	MULTIMEDIA NETWORKING	3
1754900	NES490	PRACTICAL TRAINING (2)	2
1755310	NES531	NETWORK MANAGEMENT	3
1755430	NES543	WIRELESS NETWORKS LABORATORY	1
1755530	NES553	NETWORK SECURITY LABORATORY	1
1755540	NES554	COMPUTER NETWORK DEFENSE	3
1755910	NES591	GRADUATION PROJECT (1)	1
1755920	NES592	GRADUATION PROJECT (2)	3
1764400	SE440	PROJECT MANAGEMENT	3

#### ■ Department Elective Courses 12 C.H

Line No.	Code	Course	
1755400	NES540	WIRELESS NETWORKING PROTOCOLS	3
1755410	NES541	SECURITY OF WIRELESS NETWORKS	3
1755500	NES550	INTRUSION DETECTION AND NETWORK FORENSICS	3
1755600	NES560	APPLICATIONS OF MULTIMEDIA NETWORKING	3
1755800	NES580	HIGH-SPEED NETWORKS	3
1755820	NES582	NETWORK PROCESSORS	3
1755830	NES583	OPTICAL NETWORKS	3
1755850	NES585	PROTOCOL DESIGN AND VALIDATION	3
1755930	NES593	SPECIAL TOPICS IN NETWORK ENGINEERING&SECURITY(1)	1
1755940	NES594	SPECIAL TOPICS IN NETWORK ENGINEERING&SECURITY(2)	2
1755950	NES595	SPECIAL TOPICS IN NETWORK ENGINEERING&SECURITY(3)	3

**TOTAL 160 C.H**

**\* For prerequisite & equivalent courses see the Courses' Description.**

## B.Sc. in Network Engineering and Security

### Courses' Description

#### **NES 201 Communication Skills (3C, 3H, 0L)**

This course focuses on verbal forms of communication: speaking, listening, and nonverbal. This course provides students with the information and practice they need to communicate effectively in a variety of business settings.

#### **NES 202 Introduction to UNIX (3C, 3H, 0L)**

Basic concepts of Unix, such as processes, files and directories, pipes, input/output redirection, shells, etc., the X window system (Unix's GUI) and one or more of its associated window managers, basic Unix commands and programs, and how to get help, when needed (e.g., using man), standard program development tools, such as Emacs, compilers, debuggers, the "make" facility, automated common system tasks using shell scripts and Perl, LATEX, basic system administration. *Prerequisite: CS 211*

#### **NES 301 Probability and Queuing Theory (3C, 3H, 0L)**

Probability principles and sets theory, random variables, operations on random variables, various distribution functions, introduction to random processes, weak stationary, correlation functions, linear processing, and estimation, Poisson processes and Markov chains, queuing analysis. *Prerequisite: MATH 241*

#### **NES 311 Data Communication (3C, 3H, 0L)**

Analog and digital transmission, modulation and demodulation, transmission media, data encoding, synchronous and asynchronous transmission, digital carriers, error control, multiplexing, circuit and packet switching, open system standards. *Prerequisite: CPE 231, EE 260 or Concurrent*

#### **NES 312 Fundamentals of Computer Networks (3C, 3H, 0L)**

Network architectures, communication protocols, network topologies, local area networks, internetworking devices, high-speed bridged networks, wide area networks, introduction to Internet and TCP/IP. *Prerequisite: NES 311, NES 301*

#### **NES 390 Practical Training 1 (2C)**

Eight weeks of practical training in an institution that deals with networking and security. *Prerequisite: Completion of 90 CHs*

#### **NES 411 Network Programming (3C, 3H, 0L)**

Introduction to Network Programming, Transport Layer Protocols, TCP, UDP, and SCTP, Client-Server Model, TCP Sockets, UDP Sockets, SCTP Sockets, I/O Multiplexing, DNS and Address Conversion, Threads Programming, RPC, Raw Sockets and Datalink Access. One or more of the following Internet Application Protocols and Case Studies: TELNET, HTTP, Authd, SMTP, POP, IMAP, FTP, and Web Programming (CGI, Servlets, and XML). *Prerequisite: NES 202, NES 312, CPE 470*

#### **NES 412 Network Simulation and Modeling (3C, 3H, 0L)**

Introduction to simulation concepts, discrete event simulation, random number generation, input modeling; statistical analysis of simulation, computer networks simulation, Discrete time Markov chains (DTMC),

Continuous time Markov chains (CTMC), Queuing models (M/M/1, M/M/c/k, M/G/1). Well-known network simulation packages such as ns2 and/or OPNET, are considered. *Prerequisite: NES 411*

#### **NES 413 Computer Networks Laboratory (1C, 0H, 3L)**

A set of experiments to design, apply, analyze, and evaluate communication network protocols. Students should employ their knowledge from previous courses to identify a problem, propose alternative solutions, implement a prototype using available network protocols, and evaluate the results. A final project is given that will be evaluated at the end of the laboratory. *Prerequisite: NES 312, EE 322*

#### **NES 415 Networking Protocols (3C, 3H, 0L)**

This course provides a detailed understanding of essential Internet protocols. It includes ARP, IP, ICMP, IGMP, UDP, TCP, routing protocols such as RIP, OSPF and BGP, multicasting and multicast routing protocols such as DVMRP, MOSPF and PIM, application protocols such as DNS, DHCP, FTP and HTTP. *Prerequisite: NES 312*

#### **NES 440 Wireless Networks (3C, 3H, 0L)**

This course introduces Wireless Networks which comprises of Wireless Personal Area Networks (WPAN), Wireless Local Area Networks (WLAN), and Wireless Wide Area Networks (WWAN). The course contents include physical layer standards, medium access control, building and securing WLAN, Wide Area Networks including cellular networks and cellular data networks. *Prerequisite: NES 413*

#### **NES 451 Basics of Information System Security (3C, 3H, 0L)**

Covers the concepts of information assurance, explicit and implicit policy design, use of basic computer security mechanisms, authentication, access control, policy types. Topics include: Design and use of basic network security mechanisms, asset identification and valuation, determining threats to assets and their vulnerabilities, prioritizing and selecting countermeasures, implementing and deploying countermeasures, and continuing maintenance and assessment of security mechanisms, Classical cryptography (Shift cipher, Affine cipher, Vigenere cipher, Hill cipher, and Permutation (transposition) cipher. Introduces firewalls, network intrusion detection, Viruses, Worms, Trojan horses, and other forms of malicious code. *Prerequisite: NES 301*

#### **NES 452 Cryptography and Network Security (3C, 3H, 0L)**

Introduction to the principles of number theory and the practice of network security and cryptographic algorithms. Topics include: Divisibility and the Greatest Common Divisor, Euclidean Algorithm, modular arithmetic and discrete logarithm, Primes, primality testing, Chinese Remainder Theorem, cipher) Conventional or symmetric encryption (DES, IDEA, Blowfish, Twofish, Rijndael) and public key or asymmetric encryption (RSA, Diffie-Hellman), key management and exchange, hash functions (MD5, SHA-1, RIPEMD-160, HMAC), digital signatures, certificates and authentication protocols (X.509, DSS, Kerberos), electronic mail security (PGP, S/MIME), web security and protocols for secure electronic commerce (IPSec, SSL, TLS, SET). *Prerequisite: NES 413, NES 451*

#### **NES 460 Multimedia Networking (3C, 3H, 0L)**

This introductory course in multimedia networking explores the interaction between multimedia data and the systems that need to support multimedia data such as

audio and video. Topics include: compression technologies, multimedia formats such as JPEG and MPEG, multimedia streaming over reservation-based and best-effort networks, multicasting of multimedia data, and systems support for multimedia computing.

*Prerequisite: NES 415*

#### **NES 490 Practical Training 2 (2C)**

Eight weeks of practical training in an institution that deals with networking and security. *Prerequisites: Completion of 110 C.H, NES 390 or Concurrent*

#### **NES 531 Network Management (3C, 3H, 0L)**

Provide analytical and practical capabilities to design, deploy, and manage computer networks. Topics include: basic foundations of network management, the Simple Network Management Protocol in its different versions (SNMPv1, SNMPv2, and SNMPv3), Remote network Monitoring Management Information Base (RMON1 MIB, RMON2 MIB, and SMON MIB). Telecommunications Management Network (TMN), management tools and statistics measurement, management applications including: configuration, performance, event correlation, security, reports and service levels. (*Prerequisite: NES 440, NES 452*)

#### **NES 540 Wireless Networking Protocols (3C, 3H, 0L)**

The goal of this course is to understand the challenges and latest solutions in wireless and mobile networks ad-hoc and wireless sensor networks. The focus will be on routing, auto-configuration, clustering, topology management, quality of service (QoS) reliable transport, energy conservation, mobility management, MAC, and service discovery. Both existing and proposed standards will be covered as well as current research projects in this field. Students are expected to read articles, make presentations, and participate in discussions. *Prerequisite: NES 440*

#### **NES 541 Wireless Networks Security (3C, 3H, 0L)**

This course Focuses on fundamental security issues in wireless networks security topics includes: confidentiality, Privacy, Integrity, Spoofing signal Intercept, Key management and distribution and control of fraudulent usage of networks. *Prerequisite: NES 440, NES 452*

#### **NES 543 Wireless Networks Laboratory (1C, 0H, 3L)**

This laboratory provides hands-on experience on configuring, implementing, integrating, and testing a variety of wireless technologies. Students will gain a first-hand understanding of the methods and tools for network management of wireless networks such as WLAN Network Management Systems, Routers, and Switches. *Prerequisite: NES 440*

#### **NES 550 Intrusion Detection and Network Forensics (3C, 3H, 0L)**

Fundamentals of computer security and network forensics, forensic duplication and analysis, network surveillance, intrusion detection and prevention, incident response and trace-back. Signature and anomaly based intrusion detection, Pattern matching algorithms, Viruses, Trojans and worms detection. Multicast Fingerprinting, Anonymity and Pseudonymity, Cyber law and computer security policies. *Prerequisite: NES 452*

#### **NES 553 Network Security Laboratory (1C, 0H, 3L)**

This course provides in-depth laboratory exercises using commercial-off-the-shelf (COTS) technology. Topics include: eavesdropping, implementing the attacks against ARP, IP, ICMP, TCP, and UDP protocols, exploiting DNS vulnerabilities to launch Pharming attacks, exploiting

cross-site scripting vulnerabilities and buffer overflow, implementing a simplified version of IPSec protocol. In addition students will configure network servers, routers, hubs, firewalls and intrusion detection devices to discover the effect each device can have on overall system security. *Prerequisite: NES 452*

#### **NES 554 Computer Network Defense (3C, 3H, 0L)**

Concentrates on computer network defense and countermeasures by providing a solid foundation in advanced network security fundamentals. Covers both the theoretical and practical aspects of network security. The concepts of the defense-in-depth strategy and technologies are covered along with network security policy design and implementation. This is followed by the three key network defense technologies in depth: firewalls, intrusion detection and prevention systems, and virtual private network. *Prerequisite: NES 553*

#### **NES 560 Applications of Multimedia Networking (3C, 3H, 0L)**

This course covers a broad range of topics in the frontier of multimedia computing and networking systems, focusing on transmission techniques and protocols, massive storage architectures and data security. Especially, this course covers rate and flow control, jitter management, error control and loss recovery, quality-of-service, video-on-demand, voice-over-IP, teleconferencing, multimedia over wireless networks, wide area caching systems and techniques, encryption and group key management. *Prerequisite: NES 460*

#### **NES 580 High-Speed Networks (3C, 3H, 0L)**

This course covers the current state-of-the-art in emerging high-speed network architectures, protocols and control algorithms. Topics include: basic architecture of packet networks and their network elements (switches, routers, bridges), and the protocols used to enable transmission of packets through the network. Network protocols: Ethernet, Internet, token rings, FDDI, Circuit-switched networks, ATM networks, switching, scheduling, naming, and addressing, routing, error control, flow control, traffic collection, modeling, and characterization, traffic management, connection admission control algorithms, and congestion control algorithms. *Prerequisite: NES 412*

#### **NES 582 Network Processors (3C, 3H, 0L)**

Fundamentals of Network Processing. Evolution of networking equipment and justification for Network Processors. Packet processing including pattern search, packet classification, modification, forwarding and switching. Network Processor architectures, ASICs, FPGAs, CAMs and memory based implementations. Search engines, classification processors, switch fabrics, traffic managers, storage network processors, hardware coprocessors and accelerators. *Prerequisite: NES 412*

#### **NES 583 Optical Networks (3C, 3H, 0L)**

Optical fiber and transmission technologies. First generation optical networks (SONET). Optical access networks, broadcast and select networks. IP over optical networks, MPLS, and GMPLS. The light-path concept. Wavelength division multiplexing (WDM) technology. Wavelength routing networks, related protocols and architectures. Routing and Wavelength Assignment (RWA). Optical Time Domain Multiplexing (TDM) Networks. *Prerequisite: NES 412*

#### **NES 585 Protocol Design and Validation (3C, 3H, 0L)**

This course is an introduction to the formal design, specifications, and validation of communication protocols.

Topics include: structured protocol design, protocol models, protocol validation, and protocol correctness requirements. Protocol modeling techniques such as FSM models and Petri net models are considered. Protocol verification techniques: Communicating FSM, reachability analysis, verification using checking, protocol design validation. A known verification modeling language such as PROMELA is considered. Specification and Description Language (SDL) may be considered. *Prerequisite: NES 412, NES 415*

**NES 591 Graduation Project 1 (1C)**

The student should get familiar with the theoretical and practical aspects associated with the subject matter of the project. *Prerequisite: Completion of 120 C.H, SE 440*

**NES 592 Graduation Project 2 (3C)**

The student implements, tests, and presents the project proposed in Graduation Project 1 course. *Prerequisite: NES 591*

**NES 593 Special Topics in Network Engineering and Security "1" (1C)**

Selected state-of-the-art topics in network engineering and security. *Prerequisite: Department Approval*

**NES 594 Special Topics in Network Engineering and Security "2" (2C)**

Selected state-of-the-art topics in network engineering and security. *Prerequisite: Department Approval*

**NES 595 Special Topics in Network Engineering and Security "3" (3C)**

*Prerequisite: Department Approval*  
Selected state-of-the-art topics in network engineering and security.