Networking
Domain Scope [35 hours]
1. Topology of ad hoc and fixed networks of all sizes
2. Role of the layered model in standards evolution and interoperability
3. Physical layer through routing layer issues
4. Higher layers related to applications and security, such as functions and design
5. Approaches to designing for and modeling latency, throughput, and error rate

Networking Subdomains
01 History and overview
Minimum instructional hours: 1 hour
Competencies:
   a. Define networking and describe the research scope of networking study.
   b. Identify some components of a network.
   c. Name two network devices and describe their purpose.
   d. Describe ways information technology uses or benefits from networks.
   e. Illustrate the role of networks in information technology.
   f. Identify people who influenced or contributed to the area of networks.
   g. Identify two contributors to networks and relate their achievements to the area.

02 Foundations of networking
Minimum instructional hours: 3 hours
Competencies:
   a. Identify two current standards (e.g., RFC’s and IEEE 802) and explain how standards bodies and the standardization process impact networking technology.
   b. Contrast the OSI and internet models as they apply to contemporary communication protocols.
   c. Explain why different technologies are deployed in different contexts of networking, such as topology, bandwidth, distance, and number of users.
   d. Explain the basic components and media of network systems and distinguish between LANs and WANs.
   e. Explain how bandwidth and latency impact throughput in a data communications channel.
   f. Deploy a basic Ethernet LAN and compare it to other network topologies.
   g. Explain the concept and allocation of addressing scheme which involves port numbers, IPv4 and IPv6 address.
   h. Configure a client and a server operating system and connect the client machine to the server over a LAN.
   i. Analyze and compare the characteristics of various communication protocols and how they support application requirements.
   j. Demonstrate the ability to solve basic problems and perform basic troubleshooting operations on LANs and connected devices.

03 Physical layer
Minimum instructional hours: 3 hours
Competencies:
   a. Explain how the three variables of Shannon’s law impact channel capacity.
   b. Compare the bandwidth characteristics of several types of physical communication media.
   c. Contrast the historical evolution of the switched and routed infrastructures.

   d. Analyze the physical challenges inherent in wireless-fixed and wireless-mobile communication channels.
   e. Compare methods of error detection and correction such as parity, cyclic redundancy check (CRC), and error detection and correction (EDC).
   f. Describe the development of modern communication standards, addressing both de jure and de facto standards.
   g. Choose the appropriate compression methodology (lossy or lossless) for a given type of application.
   h. Analyze and compare four networking topologies in terms of robustness, expandability, and throughput.

04 Networking and interconnectivity
Minimum instructional hours: 7 hours
Competencies:
   a. Describe the seven layers of the OSI model.
   b. Contrast the differences between circuit switching and packet switching.
   c. Contrast point-to-point network line configuration with multipoint configuration.
   d. Explain some networking and internetworking devices such as repeaters, bridges, switches, routers, and gateways.
   e. Explain network topologies such as mesh, star, tree, bus, ring, 3-D torus.
   f. Contrast connection-oriented services with connectionless services.
   g. Explain network protocol features such as syntax, semantics, and timing.
   h. Explain layered protocol software (stacks) such as physical-layer networking concepts, data-link layer concepts, internetworking, and routing.
   i. Contrast protocol suites such as IPv4, IPv6, IPvN, and TCP/UDP.
   j. Explain the operation principles of some main protocols, such as FTP and SNMP.
   k. Identify network standards and standardization bodies.

05 Routing and switching
Minimum instructional hours: 7 hours
Competencies:
   a. Describe data communications and telecommunications models, digital signal processing, topologies, protocols, standards, and architectures that are in use today.
   b. Identify the basic concepts of LAN and WAN technologies and topologies.
   c. Describe different components and requirements of network protocols.
   d. Discuss the concepts and the “building blocks” of today’s data communication networks such as switches, routers, and cabling.
   e. Explain the operation and function of 802.1 devices and protocols.
   f. Describe the necessary hardware (switches and routers) and components (routing algorithms and protocols) used to establish communication between multiple networks.
   g. Analyze the effect of various topologies, applications and devices on network performance topics such as latency, jitter, response time, window size, connection loss and quality of service.
06 Application networking services
Minimum instructional hours: 6 hours
Competencies:
   a. Describe web software stack technologies such as LAMP solution stack (Linux, Apache HTTP server, MySQL, PHP/Perl/Python).
   b. Describe the key components of a web solution stack using LAMP as an illustrative example.
   c. Explain two roles and responsibilities of clients and servers for a range of possible applications.
   d. Select three tools that will ensure an efficient approach to implementing various client-server possibilities.
   e. Design and implement a simple interactive web-based application (for example, a simple web form that collects information from the client and stores it in a file on the server).
   g. Describe two web technologies such as dynamic HTML and the client-side model, server-side model.
   h. Describe two characteristics of web servers such as handling permissions, file management, capabilities of common server architectures.
   i. Explain the support tools for website creation and web management.
   j. Explain the architecture and services of email systems.
   k. Explain the role of networking in database and file service applications.
   l. Demonstrate the working process of DNS, steps of a resolver looking up a remote name.
   m. Analyze the impact on the world-wide web portion of the internet if the majority of all routers ceased to function.
   n. Explain the problem of distributing content, the architecture of content distribution network and peer-to-peer network.

BITM Outcomes for ITMO 440
Bachelor of Information Technology and Management graduates should be able to:
(a) Apply knowledge of computing and mathematics appropriate to the program’s student outcomes and to the discipline
(b) Analyze a problem and identify and define the computing requirements appropriate to its solution
(c) Design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
(h) Recognize the need for and engage in continuing professional development
(i) Use current techniques, skills, and tools necessary for computing practice
(j) (4) Use and apply current technical concepts and practices in the core information technology of networking
(k) Identify and analyze user needs and take them into account in the selection,creation, evaluation and administration of computer-based systems

BITM Outcomes to be assessed in ITMO 440, Fall 2016
Bachelor of Information Technology and Management graduates should be able to:
(c) Design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
(h) Recognize the need for and engage in continuing professional development
(k) Identify and analyze user needs and take them into account in the selection, creation, evaluation and administration of computer-based systems

07 Network management and security
Minimum instructional hours: 8 hours
Competencies:
   a. Explain three main issues related to network management.
   b. Discuss four typical architectures for network management including the management console, aggregators and device agents.
   c. Demonstrate the management of a device such as an enterprise switch through a management console.
   d. Compare various network management techniques as they apply to wired and wireless networks such as topics on devices, users, quality of service, deployment, and configuration of these technologies.
   e. Discuss the address resolution protocol (ARP) for associating IP addresses with MAC addresses.
   f. Explain the concepts of domain names and domain name systems (DNS).
   g. Explain the dynamic host configuration protocol (DHCP).
   h. Describe two issues related to internet service providers (ISPs).
   i. Explain two quality of service issues such as performance and failure recovery.
   j. Describe ad hoc networks.
   k. Explain troubleshooting principles and techniques related to networks.
   l. Describe management functional areas related to networks.