Networking – 5%
Domain Scope
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.

Domain Competencies
A. Analyze and compare the characteristics of various communication protocols and how they support application requirements within a telecommunication system. *(Requirements and Technologies)*
B. Analyze and compare several networking topologies in terms of robustness, expandability, and throughput used within a cloud enterprise. *(Technologies)*
C. Describe different network standards, components, and requirements of network protocols within a distributed computing setting. *(Network protocol technologies)*
D. Produce managerial policies to address server breakdown issues within a banking system. *(Risk Management)*
E. Explain different main issues related to network management. *(Network Management)*

Networking Subdomains
01 Perspectives and impact
(Level 1 minimal degree of engagement)
Competencies:
a. Describe networking and the research scope of networking study.
b. Identify some components of a network.
c. Name several 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 several contributors to networks and relate their achievements to the area.

02 Foundations of networking
(Level 1 minimal degree of engagement)
Competencies:
a. Identify several current standards (e.g., RFC's and IEEE 802) and describe 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. Analyze why different technologies are deployed in different contexts of networking, such as topology, bandwidth, distance, and number of users.
d. Express the basic components and media of network systems and distinguish between LANs and WANs.
e. Describe 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. Exhibit 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
(Level 2 medium degree of engagement)
Competencies:
a. Show how the 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
(Level 3 large degree of engagement)
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. Illustrate some networking and internetworking devices such as repeaters, bridges, switches, routers, and gateways.
e. Recognize network topologies such as mesh, star, tree, bus, ring, 3-D torus.
f. Contrast connection-oriented services with connectionless services.
g. Teach network protocol features such as syntax, semantics, and timing.
h. Be aware of 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. Evaluate the operation principles of some main protocols, such as FTP and SNMP.
k. Identify network standards and standardization bodies.

05 Routing, switching, and internetworking
(Level 2 medium degree of engagement)
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. Describe 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
(Level 2 medium degree of engagement)
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. Illustrate several roles and responsibilities of clients and servers for a range of possible applications.
d. Select several 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).
f. Contrast peer-to-peer, client-server, and cloud networks.
g. Describe several web technologies such as dynamic HTML and the client-side model, server-side model.
h. Describe several characteristics of web servers such as handling permissions, file management, capabilities of common server architectures.
i. Use the support tools for website creation and web management.
j. Design the architecture and services of email systems.
k. Describe 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 most of all routers ceased to function.
n. Solve the problem of distributing content, the architecture of content distribution network and peer-to-peer network.

07 Network management
(Level 3 large degree of engagement)
Competencies:

a. Propose several 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. Exhibit the concepts of domain names and domain name systems (DNS).
g. Describe the dynamic host configuration protocol (DHCP).
h. Describe several issues related to internet service providers (ISPs).
i. Illustrate several quality-of-service issues such as performance and failure recovery.
j. Describe ad hoc networks.
k. Teach troubleshooting principles and techniques related to networks.
l. Describe management functional areas related to networks.
n. Solve the problem of distributing content, the architecture of content distribution network and peer-to-peer network.

Note: Level L1 (L1) used within a subdomain indicates a minimal degree of engagement associated with the learning proficiency of the fundamentals of the subdomain.

Levels 2 (L2) and 3 (L3) used within a subdomain indicate medium and large degrees of learning engagement associated with the application and transferring of learning to complex problems and situations.