Hall Ticket Number:

Code No. : 17455 (B) N

VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (E.C.E.) VII-Semester Main Examinations, Dec.-23/Jan.-24

Voice and Data Networks (PE-IV)

Time: **3 hours** Max. Marks: **60**

*Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B***

Part-A (10 × 2 = 20 Marks)

Q. No.	Stem of the question	M	L	CO	PO/PSO
1.	What is the basic purpose of network architecture in a communication system?	2	1	1	1/2
2.	Explain the issues involved in designing voice and data networks and how they impact network performance parameters.	2	2	1	1/2
3.	What is circuit switching, and how does it differ from packet switching?	2	1	2	1/2
4.	Discuss the blocking and non-blocking characteristics of switches and their significance in network design.	2	2	2	1/2
5.	What is the purpose of Link Layer Protocols in data networks?	2	1	3	1/2
6.	Describe the operation of Hybrid Automatic Repeat Request (HARQ) in data transmission and its importance.	2	2	3	1/2
7.	Describe the transition from 3G to 4G, emphasizing the role of OFDM.	2	1	4	1/2
8.	Explain the fundamental concepts and technologies behind LTE (Long-Term Evolution) as a 4G standard.	2	2	4	1/2
9.	Define cognitive radio technology in the context of 5G wireless networks.	2	1	5	1/2
10.	Discuss the concept of spectrum sharing in 5G and its implications for network optimization.	2	2	5	1/2
	Part-B (5 × 8 = 40 Marks)				
11. a)	Describe the importance of network latency and bandwidth.	4	2	1	1/2
b)	In a global network, data must travel from New York to Sydney, Australia. Given the distance of 12,000 miles and the speed of light in optical fiber (approximately 124,000 miles per second), calculate the one-way latency in milliseconds.	4	3	1	2/2
12. a)	Explain the concept of blocking in network switches.	3	2	2	1/2
b)	In a complex telephone exchange with 64 input ports and 64 output ports, determine the number of connection requests that can be established simultaneously without any blocking if each input port has 32 active connections.	5	4	2	2/2
13. a)	Discuss the purpose of routing tables in network routing.	3	2	3	2/2

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b)	Consider a network with three routers, A, B, and C, interconnected as follows: • Router A is directly connected to Router B with a link bandwidth of 1 Gbps and a delay of 10 ms. • Router B is directly connected to Router C with a link bandwidth of 500 Mbps and a delay of 15 ms. You are tasked with calculating the best routing path for a data packet to travel from Router A to Router C. Using the OSPF routing protocol, determine the following: i) The link cost for the connection between Router A and Router B. ii) The link cost for the connection between Router B and Router C. iii) The total cost of the path from Router A to Router C via Router B. iv) The shortest path from Router A to Router C based on OSPF cost calculations.	5	4	3	2/2
14. a)	Explain the concept of modulation and coding in LTE networks.	4	2	4	2/2
b)	In an LTE system, the received signal-to-noise ratio (SNR) is 15 dB. Calculate the achievable data rate for a 256-QAM modulation scheme with a coding rate of 0.9.	4	3	4	2/2
15. a)	Explain the concept of beamforming in the context of 5G wireless networks. Describe how beamforming technology is utilized to enhance the coverage and capacity of 5G base stations and the benefits it offers for mobile communication.	4	2	5	1/2
b)	In a spectrum-sharing scenario, two different wireless networks need to coexist in the same frequency band while avoiding interference. Consider the following parameters: • Network A uses a 20 MHz bandwidth. • Network B uses a 15 MHz bandwidth. • The networks share a common frequency band. • The minimum required guard band to prevent interference is set at 1 MHz. Calculate: i) The total available bandwidth after considering the guard band. ii) The percentage of bandwidth allocated to each network. iii) The total available bandwidth for unlicensed devices (if any) to operate in this shared spectrum. iv) The minimum distance that should be maintained between the base stations of Network A and Network B to avoid interference, assuming a free-space path loss model.	4	4	5	1/2
16. a)	In a large data center, a server cluster with high-speed links requires low-latency connections. Given a data center with 10,000 servers and each server generating 100 Gbps of traffic, calculate the total bandwidth needed for these connections. Determine if 400 10 Gbps switches can accommodate this traffic demand, and if not, suggest an alternative solution.	4	4	1	1/2

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b)	When designing a high-capacity data center network with a Clos architecture, how can you ensure non-blocking connectivity between servers and switches? Illustrate your answer for a high-capacity data center network in which each switch has 64 ports. For achieving non-blocking connectivity calculate the minimum number of switches required for the data center with 1,024 servers and provide the total number of ports in the network.	4	1	2	1/2
17.	Answer any ***two*** of the following:				
a)	In a network with three routers (A, B, and C), Router A is connected to Router B with a fast link, Router B is connected to Router C with a slower link. If Router A sends data to Router C through Router B, calculate the total time it takes for the data to reach Router C. No specific numbers or parameters are provided, just describe the concept.	4	1	3	3/2
b)	You are tasked with designing an OFDM-based system for a specific application. The requirements are as follows: • The system operates in a frequency band of 20 MHz. • You need to allocate subcarriers efficiently to achieve the best spectral efficiency. • Each subcarrier has a bandwidth of 15 kHz. • The guard interval (GI) is set to 1/16 of the symbol duration. Calculate: i) The total number of subcarriers that can be accommodated within the 20 MHz bandwidth. ii) The data rate in Mbps that can be achieved when using 64-QAM modulation for each subcarrier. iii) The overall spectral efficiency of the OFDM system in bits per second per Hertz (bps/Hz). iv) The maximum achievable data rate for this OFDM system, considering the overhead introduced by the guard interval.	4	4	4	1/2
c)	You are tasked with deploying a 5G small cell network in an urban area. Given a specific city block with dimensions of 500 meters by 500 meters, and considering the path loss model, calculate the number of small cell base stations required for complete coverage. Specify the antenna gain and carrier frequency to ensure an acceptable signal level at ground level throughout the area.	4	4	5	2/2

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

i)	Blooms Taxonomy Level – 1	22.5%
ii)	Blooms Taxonomy Level – 2	35%
iii)	Blooms Taxonomy Level – 3 & 4	42.5%

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