GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-VI

Course Title: Networking System and Communication
(Course Code:4362006)

Diploma programmer in which this course is offered	Semester in which offered
Mechatronics Engineering	VI

1. **RATIONALE**

   One of the major components of Mechatronics Engineering is Networking System and Communication. Through networks we can share hardware, Software, Processing, Data and Applications besides getting global connectivity for internet based communication and services. For diploma students it is important to understand the function of computer networks and obtain requisite knowledge about hardware and software requirements of networks and acquire skills to establish a network using necessary hardware & software tools and configure various services over it. The objectives of this course are to make students learn the technology of establishing, commissioning (making operational) and maintaining computer networks.

2. **COMPETENCY**

   The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

   - **Use Software and hardware technology to establish, Commission (make operational) and maintain computer networks.**

3. **COURSE OUTCOMES (COs)**

   The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

   i. Analyze the key concepts of data communication, the various physical network topologies and layered models.

   ii. Select proper transmission media and devices based on network requirements

   iii. Manage contemporary network infrastructures and configure fundamental network devices based on criteria and analyze communication protocols of hardware layer

   iv. Use Internet protocols and standards.

   v. Understanding of network security, cryptography, IP security, web security, information security standards.

4. **TEACHING AND EXAMINATION SCHEME**

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	70	30*	25	25	150

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit; ESE - End Semester Examination; PA - Progressive Assessment(*):

Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

5.   SUGGESTED PRACTICAL EXERCISES:

The following practical outcomes (PrOs) are the subcomponents of the COs. . These PrOs need to be attained to achieve the Cos

Sr. No.	Practical Outcomes (Pros)	Unit No.	Approximate Hours
1	Perform and Verify Ring topology using Trainer Kit	I	2
2	Introduction to Network Simulator Tool Packet Tracer Simulator.	I	2
3	Building a Simple Network	II	2
4	Using Wireshark to View Network Traffic	II	2
5	Building Ethernet Straight and Crossover Cable	II	2
6	Build a Simple Two Computers Network and Verify the Connectivity in Packet Tracer Simulator.	III	2
7	Configure and Verify the Basic Switch Settings by using 2960 Switch.	III	2
8	Set Various Passwords on 1941 Router and Verify those Passwords	III	2
9	Configure and Verify the Basic Router Settings by using 1941 Router.	III	2
10	Inter-virtual LAN Configuration using Legacy Inter-Virtual LAN Routing	IV	2
11	Implement Spanning Tree Protocol using Three Switches.	IV	2
12	Router as a Server and as a Client Configuration using DHCPv4 Protocol.	V	2

Note :- More Practical Exercises can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.

Sr.No.	Sample Performance Indicators for the PrOs	Weightage in%
	For study type	
1	Knowledge	30
2	Quality of Report	30
3	Participation	20
4	Punctuality	20

	Total	100
	For experiment type	
1	Knowledge	20
2	Procedure follows	30
3	Observation Skill	20
4	Conclusion/Summary	10
5	Quality of Report	10
6	Punctuality	10

Sample rubrics Performance Indicators for the PrOs

For study type PrOs					
Criteria	%	10	9-8	7-6	5
Knowledge	30%	Student give the correct answers 90% or more	Student give the correct answers between70-89%	Student give the correct answers between50-69%	Student give the correct answers less than 50%
		3	2.7-2.4	2.1-1.8	1.5
Quality of Report	30%	Neat Hand writing ,figure and table. complete labeling of figure and table.	Only formatting is not proper	Few required elements are missing	Several require elements are missing
		3	2.7-2.4	2.1-1.8	1.5
Participation	20%	Used time well in lab focused attention in exercise	Used time mostly in lab focused attention in exercise	Used time moderate in lab focused attention in exercise	Participation is minimum
		2	1.8-1.6	1.4-1.2	1
Punctuality	20%	Timely Submission	Submission late by 1 laboratory	Submission late by 2 laboratories	Submission late by more than 2 laboratories
		2	1.8-1.6	1.4-1.2	1

For experiment type PrOs					
Criteria	%	10	9-8	7-6	5
Knowledge	20%	Student give The correct answers90% Or more	Student give the correct answers between70-89%	Student give the correct answers between50-69%	Student give The correct Answers less than50%
		2	1.8-1.6	1.4-1.2	1
Procedure follows	30%	Student Follow all the Procedure with	Student Follow all the Procedure With some	Student Follow all the Procedure without	Student Follow all the Procedure without

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

Sr.No.	Equipment Name with Broad Specifications
1	Computer
2	Topology trainer kit, Switch, Router

LIST OF SOFTWARE
I. Cisco Packet Tracer
II. https://www.netacad.com/courses/packet-tracer

7. AFFECTIVE DOMAIN OUTCOMES

The following sample Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this competency.

a) Work as a leader/a team member.

b) Follow ethical practices.

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year

ii. 'Organization Level' in 2nd year.

iii. 'Characterization Level' in 3rd year

8. UNDERPINNING THEORY:

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
Unit – I Fundamentals of Networking System & Communication	1.a Explain data communication and its significance. 1.b Explain and distinguish various physical network topologies, including bus, ring, star, mesh, and hybrid configurations, and comprehend their implications for network design and performance. 1.c Define Protocol and standards 1.d Explain the need for layer modeling. 1.e Describe the functions of each layer of OSI Reference model. 1.f Describe the functions of each layer of TCP/IP Reference model. 1.e Describe internet model. 1.f Explain concepts in Data Communication networking	1.1 Need, Advantages and Applications of Computer Networks 1.2 Physical topologies of Network : Star, Ring, Bus, Mesh, Tree, Hybrid 1.3 Internet Standards: Protocol, Interface, Services, Primitives, semantics, syntax 1.4 Network Classification i. Based on Transmission Technologies: Point-to point, broadcast ii. Based on scale: PAN, LAN, WAN, MAN,VPN, Internet iii. Based on Architecture: Peer to Peer, Client Server, advantages of Client Server over Peer-to-Peer Model 1.5 layering of Models 1.6 OSI and TCP/IP models and their comparison 1.7 Concept of Internet model. 1.8 Concepts in Data Communication Networking
Unit – II Networking Devices	2.a Explain functions of following network devices: Repeater, Hub, Bridge, Switch ,Router, B-router, Gateway, Network Adapter, Access point, Wireless Access points and role of them at layer 2 and layer 3. 2.b Differentiate all network devices. 2.c Function firewall in network security. 2.d Describe a network management system with functions of OS, CLI, Administrative Functions, Interfaces. 2.e Explain and distinguish Ethernet, Fast Ethernet, Gigabit Ethernet. 2.f Explain wireless LAN.	2.1Classification of Transmission Media: Role of different devices 2.2 Repeaters, Hubs, Bridges, Switches(layer 2 and layer 3) 2.3 Routers 2.4 Access Points 2.5 Firewall 2.6 Introduction to Network management system (OS, CLI, Administrative Functions, Interfaces) 2.7 Ethernet, Fast Ethernet, Gigabit Ethernet 2.8 Wireless LAN
Unit – III	3.a Explain characteristics of	3.1 Physical Layer: Transmission

Networking System Hardware Layers	guided and unguided transmission media. 3.b Sketch constructional details of twisted pair, coaxial cable and fiber optic cable with labels. 3.c Explain the significance of the wireless medium as a physical layer in data communication. Discuss the key characteristics and challenges associated with using wireless communication as the physical layer. 3.d Describe ISM band and range of frequencies in it. 3.e Describe DSL technology with its types, advantages and limitations. 3.f Explain cable modem. 3.g Explain error control and flow control at data link layer in detail. 3.h Discuss error control and flow control at the data link layer. 3.i Explain HDLC, PPP, Multiple Access, CSMA,CSMA/CD and CSMA/CA. 3.j Describe and differentiate circuit switching and packet switching approach. 3.k Describe and distinguish Static and Dynamic Routing Algorithms. 3.l Explain IP addressing scheme (all types Classless and classful) with examples. 3.m Explain Different IP layer Protocols 3.n Distinguish various components of IPv4 andIPv6 protocol. 3.o Explain different Line coding types.	media (Twisted pair, Coaxial cable, Fiber optic cable) 3.2 Physical Layer Interfaces: Types of Connectors and Signals 3.3 Wireless Medium as Physical layer, 3.3 ISM Band 3.4 Circuit switching 3.5 DSL technology types-xDSLs 3.6 Cable modem 3.7 Sub Layers of Data Link Layer and functions: Error control, Flow control examples 3.8 data link protocol HDLC, PPP, Multiple Access, CSMA, CSMA/CD, CSMA/CA. 3.9 Network Layer: Packet Switching, 3.10 Virtual circuits, and datagram, Static and Dynamic Routing Algorithms 3.11 Types IP Addressing: gateway addressing, network and broadcast addressing, dotted decimal notation, loopback addressing 3.12 IP layer protocols (ICMP, ARP,RARP, DHCP, BOOTP) 3.13 IPv4 and IPv6 comparison 3.14 Line coding types
Unit – IV	4.a Explain TCP and UDP	4.1 Transport Layer: Elements of

Networking System Software Layers	protocol in transport layer in relation to connection oriented and connection less network. 4.b Role of DNS- Domain Name System. 4.c Describe the process of DNS resolution. 4.d Explain WWW and browsers 4.d Difference between IMAP and POP3 in the context of E-mail. Discuss SMTP protocol. 4.e Explain FTP and the difference between active and passive FTP modes and Remote Login 4.f Describe VoIP 4.g Describe Social Services , Forums , blogs	Transport protocols - TCP & UDP, connection oriented and connection less network. 4.2 Application Layer: 4.2.1 DNS- Domain Name System 4.2.2 Internet Services: World Wide Web: Web browser, HTML 4.2.3 Electronic Mail: Functions of Email system, User agent, Message format, Mail Protocols (SMTP, POP3),FTP, Remote Login 4.3 Voice and Video over IP 4.4 Social services: Forum, Newsgroup, blog
Unit –V Network Security	5.a key aspects related to the Copyright Act in India 5.b Define the terms "encryption" and "decryption" in the context of cryptography. 5.c Difference between symmetric and a symmetric encryption algorithms. 5.d Explain IP security 5.e Explain ISO standards and how it contributes to information security? 5.f Briefly describe the Information Technology(Amendment) Act, 2008, and its impact on cyber laws in India. 5.g Explain Social Issues , Hacking & Precautions.	5.1 Introduction to Network Security, Cryptography, symmetric and asymmetric encryption algorithms 5.2 IP security: SSH and Web security, 5.2 Information Security Standards - ISO,IT Act, Copyright Act, Cyber Laws in India. 5.3 IT Act 2000 Provisions and late stamen ments 5.4 Social issues, Hacking, precautions

Only the major Underpinning Theory is formulated as higher level UOs of Revised Bloom's taxonomy in order development of the COs and competency is not missed out y the students and teachers. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

9.   **SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN:**

Unit	Unit Title	Teaching Hours	DistributionofTheory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of Networking System & Communication	07	04	05	03	12
II	Networking Devices	08	06	04	04	14
III	Networking System Hardware Layers	12	06	06	06	18
IV	Networking System Software Layers	10	06	06	04	16
V	Network Security	5	04	02	04	10
	Total	**42**	**26**	**23**	**21**	**70**

10.   **SUGGESTED STUDENT ACTIVITIES**

Other than the laboratory learning, following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in groups and prepare reports of each activity.

i. Prepare journals based on practical performance in the laboratory.

ii. Students are encouraged to register themselves in various MOOCs such as: Swayam, edx, Coursera, Udemy etc to further enhance their learning

iii. Prepare chart to represent the Network Topology Diagrams, Protocol Stack Diagrams, Flowcharts for Protocols, Error and Flow Control Graphs, Bandwidth Utilization Charts, Network Performance Metrics, Comparison Charts for Data Link Protocols, Routing Algorithm Comparison Graphs, IP Addressing Schemes, Network Security Charts, Comparison of Wireless Technologies, Network Management Tools Comparison, Data Communication Medium Comparison, Ethical Hacking Incidents etc

iv. Explore real-world case studies of network implementations, failures, or security breaches, encouraging students to analyze and propose solutions.

v. To design a network in your department such as one drive can be accessible from any other system.

vi. Prepare LAN cable and test it.(Practice cable stripping, untwisting, and proper crimping techniques, Learn about different types of LAN cables, such as Cat5e, Cat6, or Cat6a, and their applications, Create a simple diagram or documentation illustrating the cable connections.)

vii. List different types of Network operating system.

viii. Identify the type of Network in your Institute.

11. SUGGESTED PROJECT LIST

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project is group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs.

Each student will have to maintain a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit a micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher.

MICRO PROJECT: Prepare following Designs.

1. Dynamic Cloud Network Control Under Reconfiguration Delay and Cost.
2. Measuring Web Latency and Rendering Performance.
3. Configuration to a DHCP Server
4. Implement and Verify Static Routes
5. Connectivity Tests with Trace route
6. Configure Dynamic NAT using Packet Tracer
7. Configure Switch and Router VTY, Privilege and enable Password Assignment
8. Implement and Verify Default Routes
9. Client-Server based Instant Messenger.
10. Configure VLAN in Switch
11. Configure Web browser security settings.
12. Case study on Demonstration of wireless network between mobile device and PC for file transfer. 13. Install a small wireless network using access points.
14. Develop a small Network. (Hands on Training.)

Students can do any other project suggested by faculties or any suggested student activity.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1.	Data Communication and Networking	Forouzen	Tata McGraw Hill, Education New Delhi (Latest edition)
2.	Computer Networks	Tannebaum Andrew S Wetherall David J.	Pearson, New Delhi, 5th Edition, 2011
3.	Data and Computer Communication	Stallings Williams	PHI Learning, New Delhi (Latest edition)
4.	Data Communication Networks	Sharma Sanjay	S.K. Kataria and Sons, New Delhi (Latest edition)

13. SOFTWARE/LEARNING WEBSITES

a) https://www.netacad.com/courses/packet-tracer
b) https://www.javatpoint.com/computer-network-architecture
c) https://www.geeksforgeeks.org/
d) https://www.cisco.com/c/en_in/products/security/what-is-network-security.html

14. PO-COMPETENCY-COMAPPING

Semester VI	Networking System & Communication (4362006)								
	Pos and PSOs								
Competency & Course Outcomes	PO1 Basic& Discipline specific knowledge	PO2 Problem Analysis	PO3 Design/ development of solutions	PO4 Engineering Tools,Experimentation&Testing	PO5 Engineering Practices for society, sustainability &environmen	PO6 Project Managemen	PO7 Life Long learnin	PSO1	PSO2
Competency									
CO1 Analyze the key Concepts of data communication, the various physical network topologies and layered models.	3	2	2	1	2	2	2	1	3
CO2 Select proper transmission media and devices based on network requirements	3	2	2	2	1	1	3	2	2

CO									
CO3 Manage contemporary network infrastructures and configure fundamental network devices based on criteria and analyze Communication protocols of hardware layer	3	2	2	2	1	2	3	1	3
CO4 Use Internet protocols and standards.	3	2	2	1	1	3	3	2	3
CO5 Understanding of network security, cryptography, IP security, web security, Information security standards.	3	3	1	2	2	3	3	2	3

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

15. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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