CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
ITT302	**INTERNETWORKING WITH TCP/IP**	PCC	3	1	0	4

Preamble: This subject is about the TCP/IP protocol suite and how it is used on the internet. It begins with a review of the underlying communications technologies needed for the internet. The course provides a detailed examination of IP routing, UDP, TCP, network virtualization, and label switching. Finally, internet applications and Software defined networking are discussed.

Prerequisite: ITT 305 Data Communication and Networking

Course Outcomes: After the completion of the course the student will be able to

CO No.	Course Outcomes (CO)	Bloom's Category Level
CO 1	Discuss internetworking concepts and internet address resolution.	Level2: Understand
CO 2	Illustrate the functions of IPv4, IPv6, and ICMP protocols	Level 3: Apply
CO 3	Explain internet routing architecture and internet multicasting	Level2: Understand
CO 4	Solve the design issues and protocols in transport layer	Level 3: Apply
CO 5	Explain application layer protocols, network virtualization and software defined networking	Level2: Understand

Mapping of course outcomes with program outcomes

POs COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	-	-	-	-	-	-	-	-	-	2
CO 2	3	2	2	-	-	-	-	-	-	-	-	2
CO 3	3	2	-	-	2	-	-	-	-	-	-	2
CO 4	3	2	2	-	-	-	-	-	-	-	-	2
CO 5	3	2	-	-	3	-	-	-	-	-	-	2

3/2/1: high/medium/low

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1(Marks)	Test 2(Marks)	
Remember			
Understand	40	40	80
Apply	10	10	20

Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain ARP

2. Explain different layers in TCP/IP reference model.

Course Outcome 2 (CO2)

1. Explain IP datagram fragmentation and reassembly. Also explain different header fields affected in these cases.

2. Describe the functions of ICMP

Course Outcome 3(CO3):

1. Explain characteristics and message formats in BGP.

2. Explain RIP in detail. What is slow convergence problem and how it is solved?

Course Outcome 4 (CO4):

1. Draw and explain TCP finite state machine.

2. What is label switching?

Course Outcome 5 (CO5):

1. Explain the difference between persistent and non-persistent HTTP.
2. Explain DNS.

Model Question Paper

Course Code: ITT302
Course Name: INTERNETWORKING WITH TCP/IP

Max. Marks: 100   Duration: 3 Hours

PART A

*Answer all questions. Each question carries 3 marks. (10 * 3 = 30 Marks)*

1. What is internetworking?

2. Explain the role of routers in Networks.

3. Explain the header fields in IP that are used for datagram fragmentation and reassembly

4. Explain the importance of ICMP

5. What is an autonomous system?

6. Explain about IPv6 multicast address.

7. What is VPN?

8. What is the purpose of including pseudo header while computing UDP header checksum

9. What is a cookie?

10. What is persistent HTTP?

Part B

*Answer all questions. Each question carries 14 marks. (5 * 14 = 70 Marks)*

11 List and explain the main features of all the seven layers of the ISO/OSI reference model and compare it with TCP/IP Model.

OR

12 Explain in detail about ARP.

13   Explain the format of IPv4 and IPv6 datagram.

OR

14   Explain in detail about ICMP.

15   What is BGP? Explain the characteristics and message formats of BGP.

OR

16   What is slow convergence problem? How can it be solved?

17   Explain in detail about TCP segment format.

OR

18   What is congestion? Explain in detail about TCP congestion control.

19   Explain the working of DNS.

OR

20   Explain in detail about FTP.

Syllabus

Module 1: Introduction to Internetworking (8 Hours)
Introduction & Overview – Motivation for internetworking, TCP/IP internet, Internet Services. Internetworking Concept and Architectural Model – Introduction, Application-Level Interconnection, Network-Level Interconnection, Properties Of The Internet, Internet Architecture, Interconnection Of Multiple Networks With IP Routers.   **Protocol Layering**- Introduction, The Need For Multiple Protocols, The Conceptual Layers Of Protocol Software, Functionality Of The Layers, ISO 7-Layer Reference Model, The TCP/IP 5-Layer Reference Model, Mapping Internet Addresses To Physical Addresses (ARP)
Module 2: Network Layer (8Hours)
Internet Protocol: Connectionless Datagram Delivery (IPv4, IPv6) – Introduction, Connectionless Delivery System Characteristics, Purpose And Importance Of The Internet Protocol, The IP Datagram, Datagram Type Of Service And Differentiated Services, Datagram Encapsulation, Datagram Size, Network MTU and Fragmentation, Datagram Reassembly, Header Fields Used For Datagram Reassembly, Time To Live (IPv4) And Hop

Limit (IPv6), Optional IP Items, Options Processing During Fragmentation.

Internet Protocol: Error And Control Messages (ICMP) – Introduction, The Internet Control Message Protocol, Error Reporting Vs. Error Correction, ICMP Message Delivery, 5 Conceptual Layering, ICMP Message Format

Module 3: Routing (9 Hours)
Routing Architecture – Cores, Peers and Algorithms, Routing among Autonomous system – BGP - The Scope Of A Routing Update Protocol, Determining A Practical Limit On Group Size, Autonomous System Concept, Exterior Gateway Protocols And Reachability, BGP Characteristics, BGP Functionality And Message Types, Routing Within An Autonomous System (RIP, RIPng, OSPF, IS-IS)- Introduction, Static Vs. Dynamic Interior Routes, Routing Information Protocol (RIP), Slow Convergence Problem, Solving The Slow Convergence Problem, The Disadvantage Of Using Hop Counts, Delay Metric (HELLO), Delay Metrics, Oscillation, And Route Flapping, The Open SPF Protocol (OSPF). **Internet Multicasting** – Introduction, Hardware Broadcast, Hardware Multicast, Ethernet Multicast, The Conceptual Building Blocks Of Internet Multicast, The IP Multicast Scheme, IPv4 And IPv6 Multicast Addresses, Multicast Address Semantics, Mapping IP Multicast To Ethernet Multicast, Hosts And Multicast Delivery, Multicast Scope, Multicast Routing.
Module 4: Transport Layer (10 Hours)
Transport Layer - Transport Service, The services provided to upper layers, Transport Service primitives, UDP- Segment Structure, Remote Procedure Call, RTP, and RTCP.TCP – Service model, TCP Protocol, TCP Segment Header, Connection establishment and Release, TCP finite state machine, TCP Sliding Window, TCP timer management, Congestion Control. Label switching, flows and MPLS. Network Virtualization: VPNs, NATs, And Overlays
Module 5: Application Layer (10Hours)
Application Layer- HTTP- Overview, Persistent and non-persistent Connections, Message formats, Concept of Cookies and Web Cache -FTP - Electronic Mail– SMTP, Mail message formats, POP3, IMAP – DNS- Services provided by DNS, Overview of how DNS works, DNS Caching, Message format, DHCP.Software Defined Networking (SDN, OpenFlow)

Text Books
1.Douglas E Comer, "Internetworking with TCP/IP Principles, Protocol, and Architecture" , VolumeI, 6th Edition, Pearson Education, 2013
2.Andrew S. Tanenbaum, "Computer Networks", Prentice Hall, 5th Edition
3.James F Kurose, Keith W Ross, Computer Networking: A top Down Approach featuring the Internet, Pearson Education, 3rd Edition

Reference Books
1. Behrouz A Forouzan, TCP/IP Protocol Suite, Fourth Edition

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to Internetworking**	**8 Hours**
1.1	Introduction & Overview – Motivation for internetworking, TCP/IP internet, Internet Services. Internetworking Concept And Architectural Model – Introduction, Application-Level Interconnection, Network-Level Interconnection, Properties Of The Internet, Internet Architecture, Interconnection Of Multiple Networks With IP Routers.	2Hours
1.2	Protocol Layering- Introduction, The Need For Multiple Protocols, The Conceptual Layers Of Protocol Software, Functionality Of The Layers, ISO 7-Layer Reference Model.	2Hours
1.3	The TCP/IP 5-Layer Reference Model	2Hours
1.4	Mapping Internet Addresses To Physical Addresses (ARP)	2 Hours
2	**Network Layer**	**8 Hours**
2.1	Internet Protocol: Connectionless Datagram Delivery (IPv4, IPv6) – Introduction, Connectionless Delivery System Characteristics, Purpose And Importance Of The Internet Protocol, The IP Datagram, Datagram Type Of Service And Differentiated Services, Datagram Encapsulation, Datagram Size, Network MTU and Fragmentation, Datagram Reassembly, Header Fields Used For Datagram Reassembly, Time To Live (IPv4) And Hop Limit (IPv6), Optional IP Items, Options Processing During Fragmentation.	5Hours
2.2	**Internet Protocol: Error And Control Messages (ICMP) –** Introduction, The Internet Control Message Protocol, Error Reporting Vs. Error Correction, ICMP Message Delivery, 5 Conceptual Layering, ICMP Message Format	3 Hours
3	**Routing**	**9 Hours**
3.1	Routing Architecture – Cores, Peers and Algorithms, Routing among Autonomous system – BGP - The Scope Of A Routing Update Protocol, Determining A Practical Limit On Group Size, Autonomous System Concept, Exterior Gateway Protocols And Reachability, BGP Characteristics, BGP Functionality And Message Types	2 Hours
3.2	Routing Within An Autonomous System (RIP, RIPng, OSPF, IS-IS)- Introduction, Static Vs. Dynamic Interior Routes, Routing Information Protocol (RIP), Slow Convergence Problem, Solving The Slow Convergence Problem, The Disadvantage Of Using Hop Counts, Delay Metric (HELLO), Delay Metrics, Oscillation, And Route Flapping, The Open SPF Protocol (OSPF).	5Hours
3.3	Internet Multicasting – Introduction, Hardware Broadcast, Hardware Multicast, Ethernet Multicast, The Conceptual Building Blocks Of Internet Multicast, The IP Multicast Scheme, IPv4 And IPv6 Multicast Addresses, Multicast Address Semantics, Mapping	2 Hours

	IP Multicast To Ethernet Multicast, Hosts And Multicast Delivery, Multicast Scope, Multicast Routing.	
4	**Transport Layer**	**10 Hours**
4.1	Transport Layer - Transport Service, The services provided to upper layers, Transport Service primitives, UDP- Segment Structure, Remote Procedure Call, RTP, and RTCP.	2 Hours
4.2	TCP – Service model, TCP Protocol, TCP Segment Header, Connection establishment and Release, TCP finite state machine, TCP Sliding Window, TCP timer management, Congestion Control.	4 Hours
4.3	Label switching, flows and MPLS. Network Virtualization: VPNs, NATs, And Overlays	4 Hours
5	**Application Layer**	**10 Hours**
5.1	Application Layer: - HTTP- Overview, Persistent and non persistent Connections, Message formats, Concept of Cookies and Web Cache	1 Hour
5.2	FTP - Electronic Mail– SMTP, Mail message formats, POP3, IMAP	2 Hours
5.3	DNS- Services provided by DNS, Overview of how DNS works, DNS Caching, Message format	2 Hours
5.4	DHCP	1 Hour
5.5	Software Defined Networking (SDN, Openflow)	4 Hours