

<b>Program Name</b>	<b>: Computer Engineering Program Group</b>
<b>Program Code</b>	<b>: CO/CM/IF/CW</b>
<b>Semester</b>	<b>: Fifth</b>
<b>Course Title</b>	<b>: Advanced Computer Network (Elective)</b>
<b>Course Code</b>	<b>: 22520</b>

## 1. RATIONALE

The modern computer network includes different routing protocols and applying the concepts of network, transport and application layer protocols. In order to work with existing technology in building large, complex networked systems, students must be acquainted with the principles, architectures, and protocols used in modern networked systems. This course covers advanced computer network protocols, and advanced principles of the design of computer networks. After completing this course students will be able to configure various TCP/IP protocols at different layers.

## 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Configure network protocols at different layers of TCP/IP protocol set.

## 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following *industry oriented* COs associated with the above mentioned competency:

- a) Implement Network Layer Protocols.
- b) Configure IPv6 Network.
- c) Choose routing protocol in the given network situation.
- d) Implement different Transport Layer Protocols.
- e) Configure various Application Layer Protocols.

## 4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory						Practical							
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
				Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20	

(\*): Under the theory PA; Out of 30 marks, 10 marks of theory PA are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.

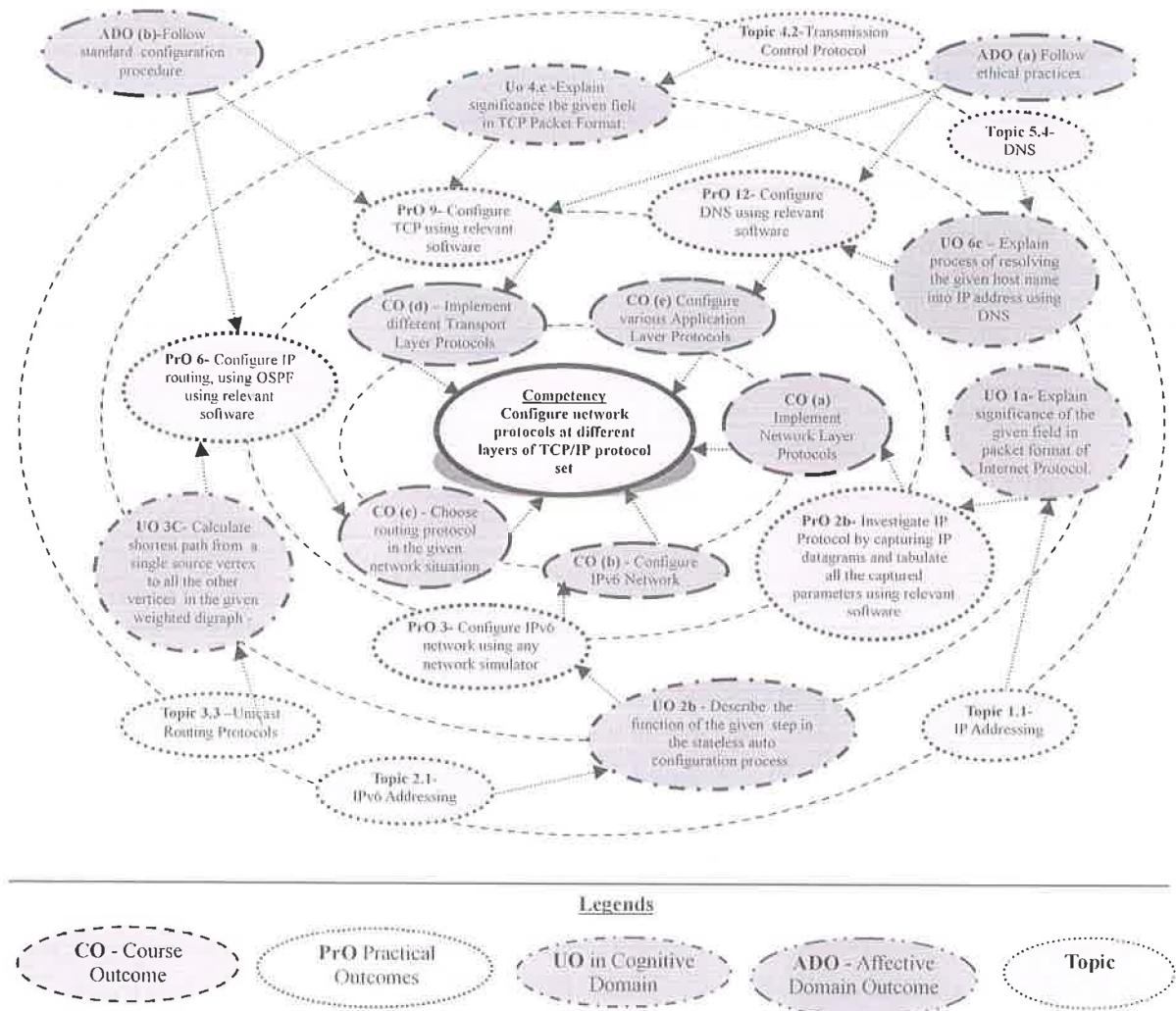
**Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment.

## 5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the



course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.



**Figure 1 - Course Map**

## 6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

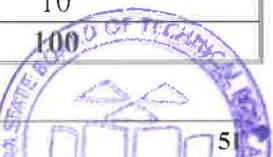
S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	<p>Given an IP address, network mask, and subnetwork mask, determine other information and implement it about the IP address such as:</p> <ol style="list-style-type: none"> <li>The subnet address of this subnet.</li> <li>The broadcast address of this subnet.</li> <li>The range of host addresses for this subnet.</li> <li>The maximum number of subnets for this subnet mask.</li> <li>The number of hosts for each subnet.</li> <li>The number of subnet bits.</li> </ol>	I	2

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	vii. The number of this subnet.		
2.	a. Capture ICMPv4 packets generated by utility programs like ping, traceroute and tabulate all the captured parameters using relevant software. b. Investigate IP Protocol by capturing IP datagrams and tabulate all the captured parameters using relevant software	I	2*
3.	Configure IPv6 network using any network simulator.	II	2*
4.	Configure IP static routing using relevant software.	III	02
5.	Configure IP routing with RIP using relevant software.	III	02*
6.	Configure IP routing with OSPF using relevant software	III	02*
7.	Configure User Datagram Protocol (UDP) Part-I using relevant software.	IV	02*
8.	Configure User Datagram Protocol (UDP) Part-II using relevant software.	IV	02*
9.	Configure Transmission Control Protocol (TCP) using relevant software.	IV	02*
10.	Run different STCP commands.	IV	02
11.	Configure Dynamic Host Configuration Protocol (DHCP) using relevant software.	V	02*
12.	Configure Domain Name Server (DNS) using relevant software.	V	02*
13.	a. Configure File Transfer Protocol (FTP) using relevant software. b. Configure Hypertext Transfer Protocol (HTTP) using relevant software.	V	02*
14.	a. Use Telnet to login a remote machine. b. Connect remote machine using Secure Shell (SSH).	V	02*
15.	Configure SMTP, POP3 and IMAP using relevant software.	V	02*
16.	Configure MIME and SNMP using relevant software.	V	02
<b>Total</b>			<b>32</b>

**Note**

- i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 12 or more practicals need to be performed, out of which, the practicals marked as '\*' are compulsory, so that the student reaches the 'Application Level' of Bloom's Taxonomy' as generally required by the industry.
- ii. The 'Process' and 'Product' related skills associated with each PrO are to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1.	Completion of given task.	25
2.	Correctness of the given task.	50
3.	Answer to sample questions.	15
4.	Submit report in time.	10
<b>Total</b>		



The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

- Follow safety practices.
- Practice good housekeeping.
- Work as a leader/a team member.
- Follow standard configuration procedures.
- Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1<sup>st</sup> year
- 'Organising Level' in 2<sup>nd</sup> year and
- 'Characterising Level' in 3<sup>rd</sup> year.

## 7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO S. No.
1	Computer system (Any computer system with basic configuration, connected to LAN)	All
2	Wireshark or any other similar software to capture and investigate packets	1, 2
3	Cisco Packet Tracer or any other similar software	3 to 16

## 8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
<b>Unit – I Network Layer and Protocols</b>	1a. Explain significance of the given field in the packet format of Internet Protocol. 1b. Implement IP addressing for the given network. 1c. Explain significance of the given field in packet format of ICMPv4. 1d. Explain the given inefficiency in Mobile IP.	1.1 <b>IP Addressing:</b> Address Space, Notations, Classfull addressing, Classless addressing, Network Address Translation (NAT). 1.2 <b>Internet Protocol (IP):</b> Datagram Format, Fragmentation, Options. 1.3 <b>ICMPv4:</b> Messages, Debugging Tools, ICMP Checksum. 1.4 <b>Mobile IP:</b> Addressing, Agents, Three Phases, Inefficiency in Mobile IP. 1.5 <b>Virtual Private Networks (VPN):</b> Technology.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
<b>Unit-II Next Generation IP</b>	2a. Map the given IPv4 address to IPv6 address. 2b. Describe function of the given step in the stateless auto configuration process. 2c. Outline the given strategy of Transition from IPv4 to IPv6. 2d. Explain significance of the given field in Datagram format of IPv6.	2.1 <b>IPv6 Addressing:</b> Representation, address space, address space allocation, Autoconfiguration, Renumbering. 2.2 <b>Transition from IPv4 to IPv6:</b> Dual Stack, Tunneling, Header Translation. 2.3 <b>IPv6 Protocol:</b> Packet format, Extension Header.
<b>Unit III- Unicast and Multicast Routing Protocols</b>	3a. Choose relevant routing Protocol for the given network situation. 3b. Compare Dynamic Routing and Static Routing on the given aspect. 3c. Calculate shortest paths from a single source vertex to all the other vertices in the given weighted digraph. 3d. Explain functioning of the given multicast routing protocol.	3.1 <b>Introduction:</b> Inter-domain, Intra-domain Routing. 3.2 <b>Routing Algorithms:</b> Distance Vector Routing, Bellman–Ford algorithm, Link State Routing, Path Vector Routing. 3.3 <b>Unicast Routing Protocols:</b> Internet Structure, Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol Version 4 (BGP4). 3.4 <b>Introduction:</b> Unicast, Multicast and Broadcast. 3.5 <b>Intradomain Multicast Protocols:</b> Multicast Distance Vector (DVMRP), Multicast Link State (MOSPF), Protocol Independent Multicast (PIM).
<b>Unit-IV Transport Layer Protocols</b>	4a. Explain significance of the given field in UDP Packet format. 4b. Describe the given State Transition of TCP. 4c. Explain significance of the given field in TCP Packet format. 4d. Describe the given field in the packet format of SCTP. 4e. Explain the functioning of the given Protocol with Flow and Error control by taking an example.	4.1 <b>User Datagram Protocol:</b> User Datagram, UDP Services, UDP Applications. 4.2 <b>Transmission Control Protocol:</b> TCP Services, TCP features, Segment, A TCP Connection, State Transition Diagram, Windows in TCP, Flow Control, Error Control, TCP Congestion Control, TCP Timers, Options. 4.3 <b>SCTP:</b> SCTP Services, SCTP Features, Packet Format, An SCTP Association, Flow Control, Error Control.
<b>Unit –V Application Layer</b>	5a. Explain function of the given application layer protocol. 5b. Explain function of the given	5.1 World Wide Web and HTTP 5.2 File Transfer: FTP and TFTP 5.3 Electronic Mail: Architecture



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
protocols	FTP command. 5c. Explain working of the given components in the Architecture of Electronic Mail. 5d. Explain process of resolving the given host name into IP address using DNS. 5e. Explain working of the given Remote Login Protocol.	Web-Based Mail, Email Security, SMTP, POP, IMAP and MIME, SNMP. 5.4 DNS – Concept of Domain name space, DNS operation. 5.5 DHCP – Static and Dynamic Allocation, DHCP Operation. 5.6 Remote Login: TELNET and SSH.

*Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Network Layer and Protocols	06	02	02	04	08
II	Next Generation IP	08	02	04	04	10
III	Unicast and Multicast Routing Protocols.	10	02	04	08	14
IV	Transport Layer Protocols	12	02	08	08	18
V	Application Layer Protocols.	12	04	08	08	20
<b>Total</b>		<b>48</b>	<b>12</b>	<b>26</b>	<b>32</b>	<b>70</b>

**Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

**Note:** This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

## 10. SUGGESTED STUDENT ACTIVITIES

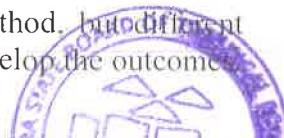
Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- Prepare journals based on practical performed in laboratory.
- Give seminar on Identified topic.
- Undertake micro-projects.

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- 'L' in item No. 4 does not mean only the traditional lecture method. It indicates types of teaching methods and media that are to be employed to develop the outcomes.



- c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
- d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
- e. Guide student(s) in undertaking micro-projects.
- f. Demonstrate students thoroughly before they start doing the practice.
- g. Encourage students to refer different websites to have deeper understanding of the topic.
- h. Observe continuously and monitor the performance of students in Lab.

## 12. SUGGESTED MICRO-PROJECTS

***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 are 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 dated work diary consisting of individual contribution 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 micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

- i. Prepare one Static and One dynamic Network with DHCP server. Use Routing Protocol to route packets between these networks using Cisco packet tracer or any other similar software.
- ii. Setup a FTP server and client on one network. Transfer files from Client to server and vice versa.
- iii. (a) Create DNS,  
 (b) Create Web server,  
 (c) Serve an HTML page on web server and call it on browser through DNS.
- iv. Set-up a mailing system of users on intranet.

## 13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Data Communication and Networking 5E	Forouzan Behrouz A.	McGraw Hill Education (India), New Delhi, 2005, ISBN-13:978-1-25-906475-3
2	Internetworking with TCP/IP, Volume I, Fourth Edition.	Comer Douglas E.	Prentice Hall of India Private Limited, New Delhi, 2014 ISBN-81-203-2065-4
3	Computer Networks, Fourth Edition	Tanenbaum Andrew S.	PHI Learning, New Delhi- 2014 ISBN-81-203-2175-8



4	Advanced Computer Network	B.M. Harwani and DT Editorial Services	Dreamtech New Delhi- 2014 ISBN 978-93-5004-013-3
5	Computer Networks Principles, Technologies And Protocols For Network Design	Natalia Olifer, Victor Olifer	Wiley ISBN

#### 14. SOFTWARE/LEARNING WEBSITES

- a) TCP/IP Illustrated, Volume 1 The Protocols W. Richard Stevens
- b) <http://study-ccna.com/>
- c) <http://www.packettracernetwork.com/>
- d) <https://www.tutorialspoint.com/listtutorials/networking/1>
- e) [www.txv6tf.org/wp-content/uploads/2010/08/Muhummad-Tutorial-ipv6-basics.pdf](http://www.txv6tf.org/wp-content/uploads/2010/08/Muhummad-Tutorial-ipv6-basics.pdf)
- f) <http://cnp3book.info.ucl.ac.be/2nd/html/protocols/bgp.html>
- g) <https://campus.barracuda.com/product/nextgenfirewallf/doc/46209264/dynamic-routing-protocols-ospf-rip-bgp/>
- h) <http://www.ciscopress.com/articles/article.asp?p=2180210andseqNum=5>
- i) [http://www.allsyllabus.com/aj/note/Computer\\_Science/Computer%20Networks%20-%20II/](http://www.allsyllabus.com/aj/note/Computer_Science/Computer%20Networks%20-%20II/)

