

Ref No:

## SRI KRISHNA INSTITUTE OF TECHNOLOGY, BANGALORE



### COURSE PLAN

Academic Year 2019-20

Program:	B E – Computer Science & Engineering
Semester :	4
Course Code:	18CS46
Course Title:	Data Communication
Credit / L-T-P:	4 / 4-0-0
Total Contact Hours:	50
Course Plan Author:	LOKESH H D

Academic Evaluation and Monitoring Cell

No.29, Chimany Hills, Hesaragatta Road, Chikkabanavara

Bangalore – 560090, KARNATAKA, INDIA

Phone / Fax :+91-08023721315/23721477

[www.skit.org.in](http://www.skit.org.in)



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Note : Remove "Table of Content" before including in CP Book  
 Each Course Plan shall be printed and made into a book with cover page  
 Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

## A. COURSE INFORMATION

### 1. Course Overview

Degree:	BE	Program:	CS
Year / Semester :	2018/4	Academic Year:	2019-20
Course Title:	DATA COMMUNICATION	Course Code:	18CS46
Credit / L-T-P:	4-0-0	SEE Duration:	3 Hours
Total Contact Hours:	50	SEE Marks:	60 Marks
CIA Marks:	40	Assignment	1 / Module
Course Plan Author:	LOKESH H D	Sign	Dt:
Checked By:		Sign	Dt:
CO Targets	CIA Target : 70%	SEE Target:	50%

**Note:** Define CIA and SEE % targets based on previous performance.

### 2. Course Content

Content / Syllabus of the course as prescribed by University or designed by institute. Identify 2 concepts per module as in G.

Module	Content	Teaching Hours	Identified Module Concepts	Blooms Learning Levels
1	Introduction: Data Communications, Networks, Network Types, Internet History, Standards and Administration, Networks Models: Protocol Layering, TCP/IP Protocol suite, The OSI model,	05	Network Terminologies	L2 Understand
1	Introduction to Physical Layer-1: Data and Signals, Digital Signals, Transmission Impairment, Data Rate limits, Performance, Digital Transmission: Digital to digital conversion (Only Line coding: Polar, Bipolar and Manchester coding).	05	Digital Transmission	L3 Apply
2	Physical Layer-2: Analog to digital conversion (only PCM), Transmission Modes, Analog Transmission: Digital to analog conversion,	05	Data transmission	L2 Understand
2	Bandwidth Utilization: Multiplexing and Spread Spectrum, Switching: Introduction, Circuit Switched Networks and Packet switching.	05	Bandwidth Utilization and Switching	L2 Understand
3	Error Detection and Correction: Introduction, Block coding, Cyclic codes, Checksum, Forward error correction,	05	Error Detection and Correction	L2 Understand
3	Data link control: DLC services, Data link layer protocols, HDLC, and Point to Point protocol (Framing, Transition phases only).	05	data link layer protocols	L2 Understand
4	Media Access control: Random Access, Controlled Access and Channelization,	05	Media Access control	L2 Understand
4	Wired LANs Ethernet: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Gigabit Ethernet and 10 Gigabit Ethernet, Wireless LANs: Introduction, IEEE 802.11 Project and Bluetooth.	05	Ethernet	L2 Understand
5	Other wireless Networks: WIMAX, Cellular Telephony, Satellite networks,	05	Wireless Networks	L2 Understand
5	Network layer Protocols : Internet Protocol, ICMPv4, Mobile IP, Next generation IP: IPv6 addressing, The IPv6 Protocol, The ICMPv6 Protocol and Transition from IPv4 to IPv6.	05	Network layer Protocols.	L4 Analyze
-	<b>Total</b>	<b>50</b>	-	-

### 3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).

1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 – 30 minutes

2. Design: Simulation and design tools used – software tools used ; Free / open source

3. Research: Recent developments on the concepts – publications in journals; conferences etc.

Modules	Details	Chapters in book	Availability
<b>A</b>	<b>Text books (Title, Authors, Edition, Publisher, Year.)</b>	-	-
1, 2, 3, 4, 5	Behrouz A. Forouzan, Data Communications and Networking 5E, 5 th Edition	1,2,3, 4,5	In Lib / In Dept
<b>B</b>	<b>Reference books (Title, Authors, Edition, Publisher, Year.)</b>	-	-
1, 2	1. Alberto Leon-Garcia and Indra Widjaja: Communication Networks – Fundamental Concepts and Key architectures, 2nd Edition Tata McGraw-Hill, 2004.		In Lib
1, 2	2. William Stallings: Data and Computer Communication, 8th Edition, Pearson Education, 2007.		Not Available
3, 4, 5	3. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2007. 4. Nader F. Mir: Computer and Communication Networks, Pearson Education, 2007		In lib
<b>C</b>	<b>Concept Videos or Simulation for Understanding</b>	-	-
C1	<a href="http://library.aceondo.net/ebooks/Computer_Science/Data_Communication_and_Networking_by_Behrouz.A.Forouzan_4th.edition.pdf">http://library.aceondo.net/ebooks/Computer_Science/Data_Communication_and_Networking_by_Behrouz.A.Forouzan_4th.edition.pdf</a> <a href="https://www.youtube.com/watch?v=mYWsllbszYQ">https://www.youtube.com/watch?v=mYWsllbszYQ</a>		
C2			
C3			
C4			
C5			
C6			
C7			
C8			
C9			
C10			
	Lab : <a href="https://www.youtube.com/watch?v=P9e7hUNPGVs">https://www.youtube.com/watch?v=P9e7hUNPGVs</a> -		
<b>D</b>	<b>Software Tools for Design</b>	-	-
<b>E</b>	<b>Recent Developments for Research</b>	-	-
<b>F</b>	<b>Others (Web, Video, Simulation, Notes etc.)</b>	-	-
1			

#### 4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

Students must have learnt the following Courses / Topics with described Content . . .

Modules	Course Code	Course Name	Topic / Description	Sem	Remarks	Blooms Level
1	17CPL16/26	CPL	Knowledge about basic networks.	1/2	Basic knowledge about computer networks.	L2
2	17PCD13/23	PCD	Knowledge about different types of networks.	1/2	Different types of networks.	L2
	-	-	Knowledge of how Data transfer will take place in the network.	-		L2

#### 5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.

Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Modules	Topic / Description	Area	Remarks	Blooms Level
1	Cellular Communication Techniques	Higher Study	Gap A seminar on Cellular technology	Understand L2
2	FM Stereo Broadcasting	Higher Study	NPTEL Video Lectures	Understand L2
3	Digital Communication Fundamentals and Application	Higher Study	NPTEL Video Lectures	Understand L2

## B. OBE PARAMETERS

### 1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs. Identify a max of 2 Concepts per Module. Write 1 CO per Concept.

Modules	Course Code.#	Course Outcome At the end of the course, student should be able to . . .	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
1	18CS46.1	Able to differentiate between OSI and TCP/IP models and identify the responsibility of each layer.	05	Network models	Discussions and Readings	Oral questions and answers and Explain	L2 Understand
1	18CS46.2	Understand the concept of data and signal.	05	Digital Transmission	Discussions and Readings	question answers and Explain	L3 Apply
2	18CS46.3	Understand and analyze the different types of Transmission media	05	Data transmission	Discussions and Readings	Analyze and examine and Take home test	L2 Understand
2	18CS46.4	Demonstrate data transmission and data conversion.	05	Data conversion.	Lecture and Readings	Analyze and examine	L2 Understand
3	18CS46.5	Describe channel coding that	05	Error	Lecture	Questions	L2

		encompasses techniques for encoding and decoding.		Detection and Correction techniques	and Reading s	are convergent and describe in oral	Understand
3	18CS46.6	Discuss different data link layer protocols.	05	data link control.	Lecture and Reading s	Oral and describe	L2 Understand
4	18CS46.7	Understand multiple access techniques and wired LANs.	05	Media Access control	Discussion and Reading s	Oral and describe	L2 Understand
4	18CS46.8	Explain basics of wireless communication.	05	Wireless LANs.	Discussion and Reading s	Oral and describe	L2 Understand
5	18CS46.9	Describe the architecture of wireless cellular telephony.	05	Wireless Networks	Reading s and Discussion	Student presentations or demonstrations within small groups	L2 Understand
5	18CS46.10	Discuss the various network layer protocols.	05	Network layer Protocols.	Reading s and Discussion	Student presentations or demonstrations within small groups	L4 Analyze
-	-	<b>Total</b>	<b>50</b>	-	-	-	-

## 2. Course Applications

Write 1 or 2 applications per CO.

Students should be able to employ / apply the course learnings to ...

Modules	Application Area Compiled from Module Applications.	CO	Level
1	Network-aware applications to connect with the network. FTP, TFTP, POP3, SMTP and HTTP	CO1	L2
1	Speech coding and transmission in digital mobile	CO2	L2
2	In Electronic devices which include twisted-pair cable, coaxial cable, and fiber optic cable.	CO3	L3
2	Computer hardware is built on the basis of certain standards	CO4	L3
3	Wireless control systems	CO5	L2
3	Ethernet for local area networks	CO6	L2
4	Earth Stations, Satellite Link Budget,	CO7	L2
4	Radio wireless technology include GPS units	CO8	L2
5	Mobile phone	CO9	L2
5	Telecommunication networks	CO10	L2

## 3. Mapping And Justification

CO – PO Mapping with mapping Level along with justification for each CO-PO pair.

To attain competency required (as defined in POs) in a specified area and the knowledge & ability required to accomplish it.

Mod	Mapping	Mapping	Justification for each CO-PO pair	Lev
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ules			Level	'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'	el
-	CO	PO	-	'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'	-
1	CO1	PO1	2.1	Apply the knowledge of OSI and TCP for Inter networking architectures.	L2
1	CO1	PO2	2.1	Having the knowledge about OSI and TCP helps in the study and design of communication networks.	L2
1	CO1	PO3	2.1	Design the solution for improving performance of a network.	L2
1	CO1	PO4	2.1	Investigate the complexity of network models and analyze the different layers in the network model.	L2
1	CO1	PO5	-	No mapping, Students will not use any Modern tools in OSI and TCP/IP models	L2
1	CO1	PO6	1.5	Different Network layers are used in Society issues	L2
1	CO1	PO7	1	OSI and TCP/IP Has Impact on Environment and development	L2
1	CO1	PO8	-	No mapping.No professional ethics and responsibilities	L2
1	CO1	PO9	-	No mapping.No individual and team work is necessary	L2
1	CO1	PO10	2.1	Understand the communication is needed between each layers in the network.	L2
1	CO1	PO11	-	No mapping , It is not applicable to manage Projects	L2
1	CO1	PO12	-	No mapping , It is not applicable to life long learnings.	L2
1	CO2	PO1	2.1	Apply the knowledge of basic concepts of the Inter networking architectures and Internet Addressing.	L2
1	CO2	PO2	2.1	Having the knowledge about the working of Transmission media helps in the study and design of communication networks.	L2
1	CO2	PO3	2.1	Design the solution for improving performance of the data-transfer in a network.	L2
1	CO2	PO4	2.1	Investigate the complexity of network issues and analyze how it works in the Transmission media	L2
1	CO2	PO5	-	No mapping, Students will not use any data and signal in modern Tools	L2
1	CO2	PO6	1.5	Data and signals are used in bio-medical applications	L2
1	CO2	PO7	1	Data and signal has Impact on Environment and development. Since it used in Audio signal processing, audio compression, digital image processing, video compression, speech processing, speech recognition, digital communications, digital synthesizers, radar, sonar, financial signal processing	L2
1	CO2	PO8	-	No mapping.No professional ethics and responsibilities	L2
1	CO2	PO9	-	No mapping.No individual and team work is necessary	L2
1	CO2	PO10	2.1	Understand the communication is needed when data is transferred in media.	L2
1	CO2	PO11	-	No mapping , It is not applicable to manage Projects	L2
1	CO2	PO12	2.1	Information acquired from the basic transmission media techniques provides lifelong learning in the context of technological change.	L2
2	CO3	PO1	2.1	Apply the basic knowledge of transferring a data on the various network medias	L3
2	CO3	PO2	2.1	Studies about the various encoding techniques helps to understand various Transmission media	L3
2	CO3	PO3	2.1	Design the techniques for Transmission media	L3
2	CO3	PO4	2.1	Research based knowledge is required to analyze the different networking media for calculating the performance of the data transfer.	L3
2	CO3	PO5	-	No mapping, Students will not use any Modern tools in analyzing the different types of Transmission media for data transmission	L2
2	CO3	PO6	-	No mapping, It is not relevant to society	L2
2	CO3	PO7	-	No mapping ,It does not have any impact on Environment and Development	L2
2	CO3	PO8	-	No mapping ,No Professional ethics	L2
2	CO3	PO9	-	No mapping ,Not functionally effective as individual or as team member	L2
2	CO3	PO10	2.1	To explain the data communication in the network it is necessary to understand the Transmission media.	L2
2	CO3	PO11	1.5	Working principle of network layer protocols is not needed to manage	L2



				the project.	
2	CO3	PO12	2.1	Ability to cope up with modulation methods used for communication after learning about the basic encoding techniques.	L2
2	CO4	PO1	2.1	Apply the basic knowledge of transferring a data transmission and data conversion in the network.	L3
2	CO4	PO2	2.1	Studies about the various encoding techniques helps to understand various transmission of data and conversion.	L2
2	CO4	PO3	2.1	Design the techniques for converting a data from one format to another format in the network channels.	L3
2	CO4	PO4	2.1	Research based knowledge is required to analyze the different networking media for calculating the performance of the data transfer.	L3
2	CO4	PO5	-	No mapping, Students will not use any Modern tools in analyzing the different types of Transmission media for data transmission	L2
2	CO4	PO6	-	No mapping, It is not relevant to society	L2
2	CO4	PO7	-	No mapping ,It does not have any impact on Environment and Development	L2
2	CO4	PO8	-	No mapping ,No Professional ethics	L2
2	CO4	PO9	-	No mapping ,Not functionally effective as individual or as team member	L2
2	CO4	PO10	2.1	To explain the data communication in the network it is necessary to understand the transmission data and conversation.	L3
2	CO4	PO11	1.5	working principle of network layer protocols is not needed to manage the project.	L2
2	CO4	PO12	2.1	Ability to cope up with modulation methods used for communication after learning about the basic encoding techniques.	L3
3	CO5	PO1	2.1	Knowledge of data-transfer in the channels in a secured format is needed to protect the data in the network by encoding and decoding.	L2
3	CO5	PO2	2.1	Knowledge of Error detection and correction of codes helps in problem analysis.	L2
3	CO5	PO3	2.1	Processes the different methodologies for encoding and decoding of data in the channels.	L2
3	CO5	PO4	2.1	Design better routing technology to transport datagrams between hosts in Internet using appropriate routing methods.	L2
3	CO5	PO5	1	Select the appropriate methodologies to overcome the limitation of the channel size for data transferring.	L2
3	CO5	PO6	-	No mapping, It is not relevant to society	L2
3	CO5	PO7	-	No mapping ,It does not have any impact on Environment and Development	L2
3	CO5	PO8	-	No mapping ,No Professional ethics	L2
3	CO5	PO9	-	No mapping ,Not functionally effective as individual or as team member	L2
3	CO5	PO10	2.1	Ability to opt the correct routing strategies and to end in better solutions for community and society using Internet.	L2
3	CO5	PO11	-	No mapping, encoding and decoding of different data link layer protocols is not needed for doing any Project works	L2
3	CO5	PO12	2.1	Information acquired from the error detection and correction provides lifelong learning in the context of technological change.	L2
3	CO6	PO1	2.1	Knowledge of data-link layer protocol help in flow control and error control.	L2
3	CO6	PO2	2.1	Knowledge of different protocols help in detecting the collision while transmitting packets.	L2
3	CO6	PO3	2.1	Processes the different protocols for error and flow control in communication channels.	L2
3	CO6	PO4	2.1	Design better protocols like stop and wait, point to point and HDLC for controlling errors.	L2
3	CO6	PO5	1	Select the appropriate data link protocols overcome the flow and error control.	L2
3	CO6	PO6	-	No mapping, It is not relevant to society	L2
3	CO6	PO7	-	No mapping ,It does not have any impact on Environment and Development	L2

3	CO6	PO8	-	No mapping ,No Professional ethics	L2
3	CO6	PO9	-	No mapping ,Not functionally effective as individual or as team member	L2
3	CO6	PO10	-	Ability to opt the correct routing strategies and to end in better solutions for community and society using Internet.	L2
3	CO6	PO11	2.1	No mapping, encoding and decoding of different data link layer protocols is not needed for doing any Project works	L2
3	CO6	PO12	-	No life long learning needed.	L2
4	CO7	PO1	2.1	Knowledge of various multiple access protocols used in communication.	L2
4	CO7	PO2	2.1	Identify the communication medium access problem using different multiple access techniques.	L2
4	CO7	PO3	2.1	Analyze and interpret the medium access over communication and could effectively plan and implement mechanisms on to solve it.	L4
4	CO7	PO4	2.1	Using multiple access protocols it is easy to understand the different shared medium access problem.	L2
4	CO7	PO5	--	No mapping , Students will not use any Modern tools	L2
4	CO7	PO6	1.5	No mapping, It is not relevant to society	L2
4	CO7	PO7		No mapping ,It does not have any impact on Environment and Development	L2
4	CO7	PO8	-	No mapping ,No Professional ethics	L2
4	CO7	PO9	-	No mapping , Not functionally effective as individual or as team member	L2
4	CO7	PO10	2.1	Understanding the multiple access protocols it is a very important aspect in accessing of data from the network.	L2
4	CO7	PO11	-	No mapping , networks and basics of wireless communication are not needed for doing projects .	L2
4	CO7	PO12	2.1	No life long learning needed.	L2
4	CO8	PO1	2.1	Knowledge of various wireless LANs used in communication.	L2
4	CO8	PO2	2.1	Identify the wireless LANs techniques and the methodologies of working of Bluetooth and backbone networks.	L2
4	CO8	PO3	2.1	Analyze and interpret the Ethernet protocols used over communication and could effectively plan and implement mechanisms on the applications	L2
4	CO8	PO4	2.1	Using Research based knowledge it is easy to understand the different type of networks.	L2
4	CO8	PO5	--	No mapping , Students will not use any Modern tools	L2
4	CO8	PO6	1.5	No mapping, It is not relevant to society	L2
4	CO8	PO7		No mapping ,It does not have any impact on Environment and Development	L2
4	CO8	PO8	-	No mapping ,No Professional ethics	-
4	CO8	PO9	-	No mapping , Not functionally effective as individual or as team member	L2
4	CO8	PO10	2.1	Understanding the network communication path is a very important aspect in accessing of data from the network.	L2
4	CO8	PO11	-	No mapping , networks and basics of wireless communication are not needed for doing projects .	
4	CO8	PO12	2.1	Information acquired from the fundamentals of wireless communication provides lifelong learning in the context of technological change.	L2
5	CO9	PO1	2.1	Knowledge of various wireless telephony networks and different protocols used in communications.	L2
5	CO9	PO2	2.1	Contribute knowledge in application services and protocols in designing proper networks in different scenarios.	L2
5	CO9	PO3	-	No mapping,Students will not develop any code in wireless networks	
5	CO9	PO4	-	Analyze the different wireless networks and various addressing protocols.	L2
5	CO9	PO5	-	No mapping,Students will not use any Modern tools in network layer protocols	L2
5	CO9	PO6	-	No mapping, It is not relevant to society	L2
5	CO9	PO7	-	No mapping ,It does not have any impact on Environment and	L2

				Development	
5	CO9	PO8	-	No mapping ,No Professional ethics	L2
5	CO9	PO9	-	No mapping ,Not functionally effective as individual or as team member	L2
5	CO9	PO10	2.1	Communication is most important to understand the cellular telephony network and to understand the network layer protocols.	L2
5	CO9	PO11	-	No mapping, working principle of network layer protocols are not needed for Projects.	L2
5	CO9	PO12	2.1	Information acquired from the basics of network layer protocols and identify the technological changes which needs lifelong learning in the context of networking.	L2
5	CO10	PO1	2.1	Knowledge of different networks layer protocols used in communications.	L2
5	CO10	PO2	2.1	Contribute knowledge in application services and protocols in designing proper networks in different scenarios using different network layer protocols.	L2
5	CO10	PO3	-	No mapping,Students will not develop any code in wireless networks	L2
5	CO10	PO4	-	Analyze the different networks and various addressing protocols.	L2
5	CO10	PO5	-	No mapping,Students will not use any Modern tools in network layer protocols	L2
5	CO10	PO6	-	No mapping, It is not relevant to society	L2
5	CO10	PO7	-	No mapping ,It does not have any impact on Environment and Development	L2
5	CO10	PO8	-	No mapping ,No Professional ethics	L2
5	CO10	PO9	-	No mapping ,Not functionally effective as individual or as team member	L2
5	CO10	PO10	2.1	Communication is most important to understand the network layer protocols.	L2
5	CO10	PO11	-	No mapping, working principle of network layer protocols are not needed for Projects.	L2
5	CO10	PO12	2.1	Information acquired from the basics of network layer protocols and identify the technological changes which needs lifelong learning in the context of networking.	L2

#### 4. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

Mod ules	CO.#	Course Outcomes At the end of the course student should be able to ...	Program Outcomes															Lev el
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
1	18CS46.1	Able to differentiate between OSI and TCP/IP models and identify the responsibility of each layer. 2.1	2.1	2.1	2.1	2.1	-	1.5	1	-	-	2.1	-	-	-	-	-	L2
1	18CS46.2	Understand the concept of data and signal.	2.1	2.1	2.1	2.1	-	1.5	1	-	-	2.1	-	2.1	-	-	-	L3
2	18CS46.3	Understand and analyze the different types of Transmission media	2.1	2.1	2.1	2.1	-	-	-	-	-	2.1	1.5	2.1	-	-	-	L2
2	18CS46.4	Demonstrate data transmission and data conversion.	2.1	2.1	2.1	2.1	-	-	-	-	-	2.1	1.5	2.1	-	-	-	L2
3	18CS46.5	Describe channel coding that encompasses techniques for encoding and decoding.	2.1	2.1	2.1	2.1	1	-	-	-	-	2.1	-	2.1	-	-	-	L2
3	18CS46.6	Discuss different data link layer protocols.	2.1	2.1	2.1	2.1	1	-	-	-	-	2.1	-	-	-	-	-	L2

4	18CS46.7	Understand multiple access techniques and wired LANs.	2.1	2.1	2.1	2.1	-	1.5	-	-	-	2.1	-	2.1	-	-	-	L2
4	18CS46.8	Explain basics of wireless communication.	2.1	2.1	2.1	2.1	-	1.5	-	-	-	2.1	-	2.1	-	-	-	L2
5	18CS46.9	Describe the architecture of wireless cellular telephony.	2.1	2.1	-	-	-	-	-	-	-	2.1	-	2.1	-	-	-	L2
5	18CS46.10	Discuss the various network layer protocols.	2.1	2.1	-	-	-	-	-	-	-	2.1	-	2.1	-	-	-	L4
-		<b>Avg CO</b>	2.1	2.1	2.1	2.1	1	1.5	1	-	-	2.1	1.5	2.1	-	-	-	-
-	PO, PSO	1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design																

## 5. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Modules	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1	Familiarization of different scrambling techniques used in data communication	Assignment	2019	-	PO8
2	Digital Communication Fundamentals and Applications	NPTEL Video Lectures	2019	-	PO10
3	Cellular Communication Techniques	NPTEL Video Lectures	2019	-	PO10

## 6. Content Beyond Syllabus

Topics & contents required (from A.5) not addressed, but help students for Placement, GATE, Higher Education, Entrepreneurship, etc.

Modules	Gap Topic	Area	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1	Cellular Communication Techniques	Cellular Network-aware	NPTEL Video Lectures	2019	-	PO10
2	FM Stereo Broadcasting	Social media network	NPTEL Video Lectures	2019	-	PO10
3	Digital Communication Fundamentals and Application	Network based IT companies	NPTEL Video Lectures	2019	-	PO10

## C. COURSE ASSESSMENT

### 1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Modules	Title	Teach. Hours	No. of question in Exam					CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg		
1	Network models and Transmission	10	2	-	-	1	1	2	CO1,CO2, L2

2	Data transmission and Data conversion.	10	2	-	-	1	1	2	CO3,CO4,	L3
3	Error Detection and Correction techniques and data link control.	10	-	2	-	1	1	2	CO5,CO6	L2
4	Media Access control and Wired and Wireless LANs.	10	-	2	-	1	1	2	CO7,CO8	L2
5	Wireless Networks and Network layer Protocols.	10	-	-	4	1	1	2	CO9,CO10	L2
-	<b>Total</b>	<b>50</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>5</b>	<b>5</b>	<b>10</b>	-	-

## 2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Mod ules	Evaluation	Weightage in Marks	CO	Levels
1, 2	CIA Exam – 1	30	CO1, CO2,CO3,CO4,	L2, L3
3, 4	CIA Exam – 2	30	CO5,CO6,CO7,CO8	L2
5	CIA Exam – 3	30	CO9,CO10	L2
1, 2	Assignment - 1	10	CO1, CO2,CO3,CO4,	L2, L3
3, 4	Assignment - 2	10	CO5,CO6,CO7,CO8	L2
5	Assignment - 3	10	CO9,CO10	L2
1, 2	Seminar - 1	-	CO1, CO2,CO3,CO4,	L2, L3
3, 4	Seminar - 2	-	CO5,CO6,CO7,CO8	L2
5	Seminar - 3	-	CO9,CO10	L2
1, 2	Quiz - 1	-	-	-
3, 4	Quiz - 2	-	-	-
5	Quiz - 3	-	-	-
1 - 5	Other Activities – Mini Project		CO1 to CO10	L2, L3, L3
	<b>Final CIA Marks</b>	<b>40</b>	-	-

## D1. TEACHING PLAN - 1

### Module - 1

<b>Title:</b>	Network models and Digital Transmission	<b>Appr Time:</b>	<b>10 Hrs</b>
<b>a</b>	<b>Course Outcomes</b>	-	<b>Blooms Level</b>
-	The student should be able to:	-	
1	Able to differentiate between OSI and TCP/IP models and identify the responsibility of each layer.	CO1	L2
2	Understand the concept of data and signal.	CO2	L2
<b>b</b>	<b>Course Schedule</b>	-	-
<b>Class No</b>	<b>Module Content Covered</b>	<b>CO</b>	<b>Level</b>
1	Introduction: Data Communications	CO1	L2
2	Networks, Network Types,Internet History	CO1	L2
3	Standards and Administration	CO1	L2
4	Networks Models: Protocol Layering	CO1	L2
5	TCP/IP Protocol suite,The OSI model	CO1	L2
6	Introduction to Physical Layer-1: Data and Signals	CO2	L2
7	Digital Signals,Transmission Impairment	CO2	L2
8	Data Rate limits,Performance	CO2	L2
9	Digital Transmission: Digital to digital conversion	CO2	L2
10	Line coding: Polar, Bipolar and Manchester coding	CO2	L2

<b>c</b>	<b>Application Areas</b>	-	-
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Network-aware applications to connect with the network. FTP, TFTP, POP3, SMTP and HTTP	CO1	L2
2	Speech coding and transmission in digital mobile	CO1	L2
<b>d</b>	<b>Review Questions</b>	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	What is data Communication? List and explain the five components of data communication system.	CO1	L2
2	Explain point-to-point connection, Multipoint, Mesh Topology, Star Topology, Bus Topology	CO1	L2
3	Explain Layers in the TCP/IP Protocols	CO1	L2
4	Explain Multiplexing and Demultiplexing	CO1	L2
5	List and Explain five Line coding schemes	CO1	L2
6	Illustrate TCP/IP protocol suite and switching criteria.	CO1	L2
7	Explain the different categories of network.	CO1	L2
8	Explain OSI layers. define following i) Noise ii) distortion iii) Attenuation	CO1	L2
9	Explain the characteristics of line coding schemes.	CO2	L2
10	Explain unipolar and polar line coding with examples.		
11	Describe bipolar and multilevel line coding schemes with examples.	CO2	L2
12	An analog signal has a bandwidth of 40KHz. If we use four levels on signal. What is the minimum bandwidth of digital signal.?	CO2	L2
13	Explain the cause for transmission impairments.	CO2	L2
14	Define the following i) Jitter ii) transmission time iii) throughput iv) Latency	CO2	L2
15	Explain bandwidth delay product.	CO2	L2
<b>e</b>	<b>Experiences</b>	-	-
1		CO1	L2
2			
3			
4		CO2	L3
5			

## Module – 2

<b>Title:</b>	Data transmission and Data conversion.	<b>Appr Time:</b>	10 Hrs
<b>a</b>	<b>Course Outcomes</b>	<b>CO</b>	<b>Blooms Level</b>
-	The student should be able to:		
1	Understand and analyze the different types of Transmission media	CO3	L3
2	Demonstrate data transmission and data conversion.	CO4	L3
<b>b</b>	<b>Course Schedule</b>		
<b>Class No</b>	<b>Module Content Covered</b>	<b>CO</b>	<b>Level</b>
1	Analog to digital conversion (only PCM)	CO3	L3
2	Transmission Modes	CO3	L3
3	Analog Transmission: Digital to analog conversion	CO4	L3
4	Bandwidth Utilization: Multiplexing and DeMultiplexing	CO4	L3
5	Switching: Introduction	CO4	L3
6	Circuit Switched Networks	CO4	L3
7	Packet switching	CO4	L3
8	Spread Spectrum	CO4	L3
9	ASK, FSK and PSK and QAM	CO4	L3
10	Parallel and Serial Transmission.	CO4	L3
<b>c</b>	<b>Application Areas</b>	-	-



-	Students should be able employ / apply the Module learnings to . . .	-	-
1	In Electronic devices which include twisted-pair cable, coaxial cable, and fiber optic cable.	CO3	L3
2	Computer hardware is built on the basis of certain standards	CO4	L3
<b>d</b>	<b>Review Questions</b>	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Explain Pulse Code Modulation in detail?	CO3	L3
2	Explain the different mechanisms for modulating digital data into an analog signal.	CO3	L3
3	Explain the Transmission Modes.	CO3	L3
4	When is the use of Multiplexing justified? Mention and explain different types of multiplexing.	CO3	L3
5	Describe the different switched networks used in computer networks, mentioning specifically which of these need setup, transfer and tear-down phase.	CO3	L3
6	Explain digital to analog conversion.	CO4	L3
7	List and explain different types of sampling.	CO4	L3
8	With a neat diagram explain binary ASK and PSK.	CO4	L3
9	Explain Quadrature phase shift keying in detail.	CO4	L3
10	Define the terms i) Modulation ii) Carrier frequency	CO4	L3
11	Explain different switching.	CO4	L3

## E1. CIA EXAM – 1

### a. Model Question Paper - 1

Crs Code:	17CS46	Sem:	IV	Marks:	30	Time:	75 minutes	
Course:	DATA COMMUNICATION							
-	-	<b>Note: Answer any 2 Full questions, each carry 15 marks.</b>				<b>Marks</b>	<b>CO</b>	<b>Level</b>
1	a	Define data communication? Explain its components and characteristics.	05	CO1	L2			
	b	Define topology and Explain the various types of topologies along with advantages and disadvantages with neat diagrams.	05	CO1	L2			
	c	Describe <b>TCP/IP</b> protocol suit with neat diagram. Discuss the functionality of each layer	05	CO1	L2			
		OR						
2	a	Explain the transmission of digital signal.	06	CO2	L2			
	b	What is transmission impairment? Mention the types of them.	03	CO2	L2			
	c	Explain polar schemes with neat diagrams.	06	CO2	L2			
3	a	Explain the addressing, encapsulation and decapsulation using TCP/IP layers. with a neat diagram	07	CO3	L3			
	b	Explain Encoder and Decoder for simple parity check with example.	08	CO3	L3			
		OR						
4	a	With neat diagram explain CRC encoder and decoder.	08	CO4	L3			
	b	Explain the types of errors and the process of error detection in block coding.	07	CO4	L3			

### b. Assignment -1

Note: A distinct assignment to be assigned to each student.

<b>Model Assignment Questions</b>								
Crs Code:	17CS46	Sem:	IV	Marks:		Time:	90 – 120 minutes	
Course:	DATA COMMUNICATION							
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.								
<b>SNo</b>	<b>USN</b>	<b>Assignment Description</b>				<b>Marks</b>	<b>CO</b>	<b>Level</b>
1		Define DC component and its effect on Digital transmission.				8	CO1	L2

2		Distinguish between a signal element and a data element.	8	CO2	L2
3		Explain the three types of transmission impairment	6	CO2	L4
4		Explain the application layer protocol in detail	8	CO2	L4
5		Explain Addressing in TCP/IP Protocols	8	CO1	L4
6		What is Line Coding? Explain with example the different Line coding schemes used for digital to digital conversion.	6	CO2	L2
7		Explain Pulse Code Modulation in detail?	6	CO3	L2
8		Explain the Transmission Modes.	6	CO4	L2
9		When is the use of Multiplexing justified? Mention and explain different types of multiplexing.	6	CO4	L2
10		What is the concept of Spread Spectrum? Explain i) Frequency Hopping Spread Spectrum (FHSS) ii) Direct Sequence Spread Spectrum (DSSS)	8	CO3	L2

## D2. TEACHING PLAN - 2

### Module - 3

<b>Title:</b>	Error Detection and Correction techniques and data link control.	<b>Appr Time:</b>	10 Hrs
<b>a</b>	<b>Course Outcomes</b>	<b>CO</b>	<b>Blooms Level</b>
-	At the end of the topic the student should be able to . . .	-	-
1	Describe channel coding that encompasses techniques for encoding and decoding.	CO5	L2
2	Discuss different data link layer protocols.	CO6	L2
<b>b</b>	<b>Course Schedule</b>		
<b>Class No</b>	<b>Module Content Covered</b>	<b>CO</b>	<b>Level</b>
1	Error Detection and Correction: Introduction	CO5	L2
2	Block coding	CO5	L2
3	Cyclic codes	CO5	L2
4	Checksum	CO5	L2
5	Forward error correction	CO5	L2
6	Data link control: DLC services	CO6	L2
7	Data link layer protocols	CO6	L2
8	HDLC Protocols	CO6	L2
9	Point to Point protocol (Framing only)	CO6	L2
10	Transition phases	CO6	L2
<b>c</b>	<b>Application Areas</b>	-	-
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Wireless control systems	CO5	L2
2	Ethernet for local area networks	CO6	L2
<b>d</b>	<b>Review Questions</b>	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Describe different types of errors.	CO5	L2
2	Infer the meaning of hamming distance? Explain the block diagram of simple parity check code C (5, 4) with $d_{min} = 2$ .	CO5	L2
3	What is a High – level Data Link Control (HDLC) protocol? Indicate in diagrammatic form, the frame format of different HDLC frames.	CO6	L2
4	What is framing? Explain a. Character Oriented framing b. Bit Oriented framing.	CO6	L2
5	Find the code word, using CRC given data word "1001" and generator "1011".	CO5	L2
6	Explain with neat diagram the error detection in block coding.	CO5	L2
7	Explain how CRC used in detecting errors for the following polynomial	CO5	L2



	$g(x)=x+1$ and $d(x)=1101011011$		
8	Explain DLC services in datalink control.	CO6	L2
9	Explain stop and wait protocol.	CO6	L2
10	Explain HDCL Proctol.	CO6	L2
<b>e</b>	<b>Experiences</b>	-	-
		CO6	L2
		CO6	L3

## Module – 4

<b>Title:</b>	Media Access control and Wired and Wireless LANs.	<b>Appr Time:</b>	10 Hrs
<b>a</b>	<b>Course Outcomes</b>	<b>CO</b>	<b>Blooms Level</b>
-	At the end of the topic the student should be able to . . .	-	-
1	Understand multiple access techniques and wired LANs.	CO7	L2
2	Explain basics of wireless communication.	CO8	L2
<b>b</b>	<b>Course Schedule</b>		
<b>Class No</b>	<b>Module Content Covered</b>	<b>CO</b>	<b>Level</b>
1	Media Access control: Random Access	CO7	L2
2	Controlled Access and Channelization	CO7	L2
3	Wired LANs Ethernet: Ethernet Protocol	CO7	L2
4	Standard Ethernet	CO7	L2
5	Fast Ethernet	CO7	L2
6	Gigabit Ethernet	CO8	L2
7	Wireless LANs: Introduction	CO8	L2
8	IEEE 802.11 Project	CO8	L2
9	Bluetooth.	CO8	L2
10	10 Gigabit Ethernet	CO8	L2
<b>c</b>	<b>Application Areas</b>	-	-
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Earth Stations, Satellite Link Budget,	CO7	L2
2	Radio wireless technology include GPS units	CO8	L2
<b>d</b>	<b>Review Questions</b>	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	What is random access? Explain following random access protocols. a. Pure ALOHA b. Slotted ALOHA	CO7	L2
2	Explain any two popular controlled access methods, with a neat diagram.	CO7	L2
3	Discuss IEEE 802.3 MAC frame format. Mention the restriction imposed on minimum and maximum lengths of an 802.3 frame.	CO8	L2
4	Explain the IEEE 802.11 architecture.	CO8	L2
5	Explain three types of controlled access.	CO7	L2
6	Explain different channelization.	CO7	L2
7	Describe ethernet protocol.	CO7	L2
8	List and explain characteristics of standard ethernet.	CO7	L2
9	Explain the frame work of PCF	CO8	L2
10	Explain bluetooth architecture.	CO8	L2
11	Explain the transition phase with diagram	CO8	L2
12	Explain different types of services in wireless LANS	CO8	L2
<b>e</b>	<b>Experiences</b>	-	-

1		CO7	L2
2			
3			
4		CO8	L3
5			

## E2. CIA EXAM – 2

### a. Model Question Paper - 2

Crs Code:	17CS46	Sem:	IV	Marks:	30	Time:	75 minutes	
Course:	DATA COMMUNICATION							
-	-	<b>Note: Answer all questions, each carry equal marks. Module : 3, 4</b>				<b>Marks</b>	<b>CO</b>	<b>Level</b>
1	a	Explain stop and wait protocol with appropriate diagrams.				7	CO5	L2
	b	What is Internet checksum? List the steps undertaken by sender and receiver for error detection in Internet checksum				8	CO5	L2
		OR						
2	a	Explain polling and reservation of controlled access with diagram.				8	CO6	L2
	b	Explain working of CSMA/CA with suitable flow diagram				7	CO5	L2
		OR						
3	a	Explain different frame types in HDLC.				8	CO8	L2
	b	Explain transition phases of PPP protocol with neat diagram.				7	CO8	L2
		OR						
4	a	What is channelization? Explain FDMA				7	CO7	L2
	b	Describe pure ALOHA and slotted ALOHA				8	CO7	L2

### b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

<b>Model Assignment Questions</b>								
Crs Code:	17CS46	Sem:	IV	Marks:		Time:	90 – 120 minutes	
Course:	DATA COMMUNICATION							
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.								
<b>SNo</b>	<b>USN</b>	<b>Assignment Description</b>				<b>Marks</b>	<b>CO</b>	<b>Level</b>
1		Explain with example error detection with respect to block coding.				8	CO5	L2
2		Find the code word $c(x)$ , using CRC for the information $d(x) = x^3 + 1$ with generator polynomial $t(x) = x^3 + x + 1$				8	CO5	L2
3		What is internee checksum? With an example list the steps done by the sender and the receiver for error detection.				10	CO6	L2
4		Briefly explain the forward error correction.				5	CO6	L2
5		Explain a. Simple Protocol b. Stop and Wait Protocol					CO7	L2
6		Explain PPP and Transition Phases				8	CO8	L2
7		Explain the following random access protocols along with the neat flow diagram. a. CSMA b. CSMA/CD c. CSMA/CA				12	CO7	L2
8		Write short notes on four of the popular standard Ethernet common implementations.				8	CO7	L2
9		Explain the following channelization techniques. a. FDMA b. TDMA c. CDMA				12	CO7	L2
10		Discuss the IEEE 802.11 MAC layer frame format along with the addressing mechanisms.				8	CO8	L2
11		Explain Bluetooth Layers. Explain the architecture of Bluetooth.				8	CO8	L2

## D3. TEACHING PLAN - 3

## Module – 5

<b>Title:</b>	Basic processing unit and Embedded system	<b>Appr Time:</b>	10 Hrs
<b>a</b>	<b>Course Outcomes</b>	<b>CO</b>	<b>Blooms Level</b>
-	At the end of the topic the student should be able to . . .	-	
1	Describe the architecture of wireless cellular telephony.	COg	L2
2	Discuss the various network layer protocols.	CO10	L2
<b>b</b>	<b>Course Schedule</b>		
<b>Class No</b>	<b>Module Content Covered</b>	<b>CO</b>	<b>Level</b>
1	Other wireless Networks: WIMAX	COg	L2
2	Cellular Telephony	COg	L2
3	Satellite networks	COg	L2
4	Network layer Protocols : Internet Protocol	CO10	L2
5	ICMPv4	CO10	L2
6	Mobile IP	CO10	L2
7	Next generation IP: IPv6 addressing	CO10	L2
8	The IPv6 Protocol	CO10	L2
9	The ICMPv6 Protocol	CO10	L2
10	Transition from IPv4 to IPv6.	CO10	L2
<b>c</b>	<b>Application Areas</b>	-	-
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Mobile phone	COg	L2
2	Telecommunication networks	CO10	L2
<b>d</b>	<b>Review Questions</b>	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Explain IPv4 datagram format (along with options explanation)	CO10	L2
2	Explain the following debugging tools a. PING b. Tracert	CO10	L2
3	Explain the IPv6 addressing mechanisms.	CO10	L2
4	Explain the IPv6 Packet format.	CO10	L2
5	Explain datagram format.	COg	L2
6	Describe data fragmentation.	COg	L2
7	Explain general format for ICMP.	CO10	L2
8	Distinguish between IPV4 and IPV6.	CO10	L2
9	Give the frame format of 802.11 and explain	COg	L2
10	Define terms piconet and scatternet.	COg	L2
11	Using an example show the checksum calculation in ICMP4	COg	L2
12	What is meant by hidden station problem.explain.	CO10	L2
<b>e</b>	<b>Experiences</b>	-	-
1		CO10	L2
2		COg	
3			
4		COg	L3
5			

### E3. CIA EXAM – 3

#### a. Model Question Paper - 3

Crs Code:	17CS46	Sem:	IV	Marks:	30	Time:	75 minutes	
Course:	DATA COMMUNICATION							
-	-	<b>Note: Answer any 2 questions, each carry equal marks.</b>				<b>Marks</b>	<b>CO</b>	<b>Level</b>
1	a	Explain IEEE802.11 project architecture.				8	CO9	L2
	b	Explain the operation of cellular telephony.				7	CO9	L2
		OR						
2	a	Explain briefly the 3 categories of satellites.				8	CO9	L2
	b	Explain different types of addressing mechanism in IEEE 802.11.				7	CO9	L2
		OR						
3	a	Discuss 802.11 MAC frame format.				8	CO10	L2
	b	Explain Bluetooth architecture with neat diagram.				7	CO10	L2
		OR						
4	a	Explain IP datagram header format with neat diagram and give description of each field.				8	CO10	L2
	b	Explain WiMax Architecture.				7	CO10	L2
	b	Explain in detail, the yagi-uda antenna. Write the design equations for dimensions of different elements of antenna				5	CO10	L2
	c	Write a note on paraboloid? Explain the principle of parabolic reflector with the help of a neat diagram.				5	CO10	L2

#### b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

<b>Model Assignment Questions</b>								
Crs Code:	17CS46	Sem:	IV	Marks:	5 / 10	Time:	90 – 120 minutes	
Course:	DATA COMMUNICATION							
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.								
<b>SNo</b>	<b>USN</b>	<b>Assignment Description</b>				<b>Marks</b>	<b>CO</b>	<b>Level</b>
1		Write short notes on a. WiMAX b. Cellular Telephony c. Satellite Networks				5	CO9	L2
2		Write short notes on ICMPv4 and ICMPv6 messages.				5	CO9	L3
3		Explain the concept of Mobile IP.				8	CO10	L4
4		Explain the advantages of IPv6 over IPv4				5	CO10	L3
5		Explain the different methods of transition from IPv4 to IPv6				8	CO10	L3
6		Distinguish between IPV4 and IPV6.				6	CO5	L2
7		Give the frame format of 802.11 and explain				5	CO5	L2
8		Define terms piconet and scatternet.				4	CO5	L2
9		Using an example show the checksum calculation in ICMP4				8	CO5	L2
10		What is meant by hidden station problem.explain.				5	CO5	L2
11		Explain IPv4 datagram format (along with options explanation)				5	CO5	L2
12		Explain the following debugging tools a. PING b. Tracert				5	CO5	L2

### F. EXAM PREPARATION

#### 1. University Model Question Paper

Course:	DATA COMMUNICATION				Month / Year	May / 2019		
Crs Code:	17CS46	Sem:	IV	Marks:	100	Time:	180 minutes	
Mod ule	<b>Note</b>	Answer all FIVE full questions. All questions carry equal marks.				<b>Marks</b>	<b>CO</b>	<b>Level</b>
1	a	What is data Communication? List and explain the five components of data communication system.				6	CO1	L2

	b	What are the four levels of addresses used in internet employing TCP/IP?	8	CO1	L2
	c	With sketch, explain two types of wide area network in use.	6	CO1	
		<b>OR</b>			
1	a	Four 1-kbps connections are multiplexed together. A unit is 1 bit. Find (1) the duration of 1 bit before multiplexing, (2) the transmission rate of the link, (3) the duration of a time slot, and (4) the duration of a frame.	10	CO2	L2
	b	Define direct sequence spread spectrum (DSSS) and explain how it achieves bandwidth spread using relevant sketch.	10	CO2	L2
2	a	Write a descriptive note on three causes of transmission impairment.	8	CO3	L4
	b	Explain the transmission modes?	6	CO3	L4
	c	Explain PCM in detail.	6	CO3	L4
		<b>OR</b>			
2	a	Define the following: a. Frequency shift Keying: b. Base band transmission: c. Broad band transmission: d. SNR: e. Nyquist bit rate:	10	CO4	L4
	b	Draw the graph of the NRZ-L, NRZ-I, Manchester, differential Manchester scheme using each of the following data streams, assuming that the last signal level has been positive. a. 00000000 b. 11111111 c. 01010101 d. 00110011	10	CO4	L4
3	a	What is FDM? Briefly explain its multiplexing and demultiplexing process.	6	CO5	L2
	b	Four sources create 250 characters per second. The frame contain one character from each source create 250 characters per second. The frame contain one character from each source and one extra bit for synchronization.	6	CO5	L2
	c	What is time division multiplexing? Explain how statistical TDM overcomes the disadvantages of synchronous TDM.	8	CO5	L2
		<b>OR</b>			
3	a	With neat sketch, explain two approaches used in variable size framing.	8	CO6	L2
	b	What are the three types of HDLC frames used in HDLC bit oriented protocol? Explain its significance with its structure. Show how that frames can be used for exchange of data using piggy backing.	8	CO6	L2
	c	Show two types of networks used in Bluetooth	4	CO6	L2
4	a	Explain error detection and error correction with respect to block coding	8	CO7	L2
	b	Find the codeword using CRC given data word "1001" and generator "1011"	9	CO7	L2
	c	Describe different types of errors.	3	CO7	L2
		<b>OR</b>			
4	a	Explain the frame format and transitional phases of point to point protocol.	8	CO8	L2
	b	With neat sketch, explain BSS and ESS	8	CO8	L2
	c	Explain with necessary sketch IEEE 802.11 addressing mechanism	4	CO8	L2
5	a	Describe 802.3 Mac frame	8	CO9	L2
	b	Explain: i) CSMA ii) CSMA/CD	12	CO9	L2
		<b>OR</b>			

5	a	Explain IEEE 802.11 architecture.	10	CO10	L2
	b	Explain in detail IPv6 packet format	10	CO10	L2

## 2. SEE Important Questions

Course:	DATA COMMUNICATION				Month / Year	May / 2019	
Crs Code:	17CS46	Sem:	IV	Marks:	100	Time:	180 minutes
	<b>Note</b>	Answer all FIVE full questions. All questions carry equal marks.				-	-
Mod ule	Qno.	Important Question				Marks	CO Year
Mod ule	Qno.	Important Question				Marks	CO Year
1	1	What is data communication? Explain with neat sketch three types of communication between the devices considering data flow.				8	CO1 2014
	2	Give four levels of addresses used in TCP/IP protocol and give its significances				4	CO1 2017
	3	Explain different types of transmission modes.				4	CO2 2015
	4	Four 1-kbps connections are multiplexed together. A unit is 1 bit. Find (1) the duration of 1 bit before multiplexing, (2) the transmission rate of the link, (3) the duration of a time slot, and (4) the duration of a frame.				10	CO2 2015
	5	Define direct sequence spread spectrum (DSSS) and explain how it achieves bandwidth spread using relevant sketch				8	CO2 2016
2	1	What is Latency? List out its components				8	CO3 2017
	2	Give the block diagram of PCM encoder and state the role of each processes.				8	CO3 2018
	3	What is multiplexing? Differentiate synchronous TDM with statistical TDM giving the working of both procedures in brief				10	CO3 2017
	4	Give the block diagram of PCM encoder and state the role of each processes.				7	CO4 2016
	5	What is Line Coding? Explain with example the different Line coding schemes used for digital to digital conversion.				8	CO4 2015
3	1	Give the details of minimum and maximum length of Ethernet frame. With an example, explain the format of Ethernet addresses.				8	CO5 2015
	2	Explain working of CDMA with suitable example.				8	CO5 2015
	3	Explain PPP and Transition Phases				8	CO5 2017
	4	Find the codeword using CRC given data word "1001" and generator "1011".					CO6 2014
	5	What is a High - level Data Link Control (HDLC) protocol? Indicate in diagrammatic form, the frame format of different HDLC frames.				10	CO6 2015
4	1	Explain with necessary sketch IEEE 802.11 addressing mechanism				8	CO7 2014
	2	Mention the five goals of fast Ethernet. And give the importance of "AUTONEGOTIATION"				8	CO7 2016
	3	Mention different categories of standard Ethernet and explain implementation of 10 base 5 thick Ethernet.				8	CO7 2017
	4	Describe 802.3 Mac frame				8	CO8 2018
	5	What is random access? Explain following random access protocols. a. Pure ALOHA b. Slotted ALOHA				10	CO8 2014
5	1	List the deficiency of IPv4 and advantages of IPv6 over IPv4				8	CO9 2015
	2	Explain the following debugging tools a. PING b. Tracert				6	CO9 2016
	3	Give the IPv4 datagram format and brief description of each field				8	CO9 2015
	4	Draw format of IPv6 datagram and explain.				8	CO10 2014
	5	Explain the concept of Mobile IP.				8	CO10 2017

## G. Content to Course Outcomes

### 1. TLPA Parameters

**Table 1: TLPA**

Module #	Course Content or Syllabus (Split module content into 2 parts which have similar concepts)	Content Teaching Hours	Blooms' Learning Levels for Content	Final Blooms' Level	Identified Action Verbs for Learning	Instruction on Methods for Learning	Assessment Methods to Measure Learning
A	B	C	D	E	F	G	H
1	Introduction: Data Communications, Networks, Network Types, Internet History, Standards and Administration, Networks Models: Protocol Layering, TCP/IP Protocol suite, The OSI model,	05	- L1 - L2	L2	- Understand - Able to differentiate	- Lecture	Oral question answers and Explain
1	Introduction to Physical Layer-1: Data and Signals, Digital Signals, Transmission Impairment, Data Rate limits, Performance, Digital Transmission: Digital to digital conversion (Only Line coding: Polar, Bipolar and Manchester coding).	05	- L2 - L3	L3	- Understand - Apply in conversion of data	- Lecture - Tutorial	question answers and Explain
2	Physical Layer-2: Analog to digital conversion (only PCM), Transmission Modes, Analog Transmission: Digital to analog conversion,	05	- L1 - L2	L2	- Understand - data transmission in various forms.	- Lecture	Analyze and examine and Take home test
2	Bandwidth Utilization: Multiplexing and Spread Spectrum, Switching: Introduction, Circuit Switched Networks and Packet switching,	05	- L1 - L2	L2	- Understand - channel utilization.	- Lecture	Analyze and examine
3	Error Detection and Correction: Introduction, Block coding, Cyclic codes, Checksum, Forward error correction,	05	- L1 - L2	L2	- Understand - various Techniques for detecting and correcting errors in data.	- Lecture	Questions are convergent and describe in oral
3	Data link control: DLC services, Data link layer protocols, HDLC, and Point to Point protocol (Framing, Transition phases only).	05	- L1 - L2	L2	- Understand - different protocols used in data-link layer.	- Lecture - Tutorial	Oral and describe
4	Media Access control: Random Access, Controlled Access and Channelization,	05	- L1 - L2	L2	- Understand	- Lecture - Tutorial	Oral and describe

					- accessing the channel for communication.		
4	Wired LANs Ethernet: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Gigabit Ethernet and 10 Gigabit Ethernet, Wireless LANs: Introduction, IEEE 802.11 Project and Bluetooth.	05	- L1 - L2	L2	- Understand -various Ethernet protocols.	- Lecture - Tutorial	Oral and describe
5	Other wireless Networks: WIMAX, Cellular Telephony, Satellite networks,	05	- L1 - L2	L2	- Understand -various types of wireless network.	- Lecture	Student presentations or demonstrations within small groups
5	Network layer Protocols : Internet Protocol, ICMPv4, Mobile IP, Next generation IP: IPv6 addressing, The IPv6 Protocol, The ICMPv6 Protocol and Transition from IPv4 to IPv6.	05	- L3 - L4	L4	-Analyze -different protocols of the network layer.	- Lecture	Student presentations or demonstrations within small groups

## 2. Concepts and Outcomes:

**Table 2: Concept to Outcome**

Module #	Learning Outcome from study of the Content or Syllabus	Identified Concepts from Content	Final Concept	Concept Justification (What all Learning Happened from the study of Content / Syllabus. A short word for learning or outcome)	CO Components (1.Action Verb, 2.Knowledge, 3.Condition / Methodology, 4.Benchmark)	Course Outcome  <b>Student Should be able to ...</b>
A	I	J	K	L	M	N
1	- Study of Network Types - Study of Internet Standards and Administration - Study of Networks Models	- Networks Models -Internet Standards and Administration	Network Terminologies	Knowledge about data communication and standards of Internet.	- Understand - Working various Layers in network	Able to differentiate between OSI and TCP/IP models and identify the responsibility of each layer.
1	- Study of Data and Signals - Study of Digital	- Physical Layer-1 -Data and Signals	Digital Transmission	Knowledge of various layers in the transmission media.	- Apply -Transmission Lines - Line coding Methods	Understand the concept of data and signal.



	Transmission - Study of Line coding					
2	- Study of Physical Layer-2 - Study of Transmission Modes - Study of Analog Transmission	-Physical Layer-2 - Transmission Modes	Data transmission	Knowledge of data transmission in various forms.	- Understand Transmission media - Types of networks	Understand and analyze the different types of Transmission media
2	- Study of Bandwidth Utilization: - Study of Spread Spectrum - Study of Switching	- Multiplexing in channel - Spread Spectrum	Bandwidth Utilization and Switching	Knowledge of channel utilization.	- Understand Working - Bandwidth and switching	Demonstrate data transmission and data conversion.
3	- Study of Block coding, Cyclic codes - Study of Checksum - Study of Forward error correction,	- techniques for detecting the errors in data. - techniques for correcting the errors in data	Error Detection and Correction	Knowledge of various Techniques for detecting and correcting errors in data.	- Understand Working - various techniques.	Describe channel coding that encompasses techniques for encoding and decoding.
3	- Study of DLC services - Study of Data link layer protocols - Study of Framing, Transition phases	- DLC services - Framing in DLL	data link layer protocols	Knowledge of different protocols used in data-link layer.	- Understand Protocols - Role of various protocols in data-link layer.	Discuss different data link layer protocols.
4	- Study of Random Access - Study of Controlled Access protocols - Study of Channelization	-Methods for accessing the channel. - Techniques for controlling the channel.	Media Access control	Knowledge of accessing the channel communication.	- Understand multiple accessing in the network. - utilization of channel.	Understand multiple access techniques and wired LANs.
4	- Study of Ethernet Protocol - Study of Standard Ethernet, Fast Ethernet	-Wired LANs - Wireless LANs	Ethernet	Knowledge of various Ethernet protocols.	- Understand Ethernet Protocol - Standard Ethernet	Explain basics of wireless communication.

	- Study of IEEE 802.11 Project and Bluetooth					
5	- Study of WIMAX - Study of Cellular Telephony - Study of Satellite networks,	-WIMAX -Various networks types	Wireless Networks	Knowledge of various types of wireless network.	- Understand - Working - wireless network.	Describe the architecture of wireless cellular telephony.
5	- Study of Internet Protocol, ICMPv4, Mobile IP - Study of IPv6 addressing, The IPv6 Protocol - Study of ICMPv6 Protocol and Transition from IPv4 to IPv6.	-Internet Protocol - IPv6 and IPv4	Network layer Protocols.	Knowledge of different protocols of the network layer.	- Analyze - Working - different protocols of the network layer.	Discuss the various network layer protocols.