


<b>CMR Institute of Technology, Bengaluru-560037</b>			
<b>Department :</b> Telecommunication Engineering			
<b>Semester:</b> VI	<b>Section:</b> A	<b>Lectures/week:</b> 05	
<b>Subject :</b> Digital Communication		<b>Code:</b> 15EC61	
<b>Course Instructor:</b> Prof. Raveesh Hegde			
<b>Course duration:</b> 05 Feb 2018 – 25 May 2018			
<b>Course Site:</b> <a href="https://sites.google.com/a/cmrit.ac.in/raveesh-hegde/courses/digital-communication">https://sites.google.com/a/cmrit.ac.in/raveesh-hegde/courses/digital-communication</a>			

### Course Objectives

- To explain the conversion of bandpass signal to equivalent low pass signal
- To explain the principles of detection of known signals in a noisy environment
- To explain the various digital modulation techniques
- To explain the principles of communication through band-limited channels
- To explain the principles of spread spectrum communication

### Prerequisites

- Basics of Signals and Systems, LTI Systems, Convolution
- Fourier Series and Fourier Transform
- Basics of Probability and Random Process

### Lesson Plan

Lecture #	Book & Sections	Topics	Teaching Aids	% of Syllabus Covered
1-5	TB1, Chapter 2	<b>Basics of Signals and Systems:</b> LTI Systems, Convolution, Fourier Series, Fourier Transform	Chalk and Talk, Video Lectures	--
<b>Links to some useful online lectures:</b> <ul style="list-style-type: none"> <li>➤ <a href="https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/lecture-4-convolution/">https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/lecture-4-convolution/</a></li> <li>➤ <a href="https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/lecture-7-continuous-time-fourier-series/">https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/lecture-7-continuous-time-fourier-series/</a></li> <li>➤ <a href="https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/lecture-8-continuous-time-fourier-transform/">https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/lecture-8-continuous-time-fourier-transform/</a></li> <li>➤ <a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-003-signals-and-systems-fall-2011/lecture-videos/lecture-15-fourier-series/">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-003-signals-and-systems-fall-2011/lecture-videos/lecture-15-fourier-series/</a></li> <li>➤ <a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-003-signals-and-systems-fall-2011/lecture-videos/lecture-16-fourier-transform/">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-003-signals-and-systems-fall-2011/lecture-videos/lecture-16-fourier-transform/</a></li> </ul>				
6-10	TB1, Chapter 3	<b>Probability and Random Process:</b> Introduction and Definitions, Conditional Probability and Statistical Independence, PDF and CDF, Joint and Conditional Density Functions, Random Processes, Wide Sense and	Chalk and Talk, Video Lectures	--

		Strict Sense Stationarity, Autocorrelation and Power Spectral Density.		
<b>Links to some useful online lectures:</b>				
<ul style="list-style-type: none"> <li>➤ <a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/lecture-13-random-processes/">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/lecture-13-random-processes/</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=r1sLCDA-kNY">https://www.youtube.com/watch?v=r1sLCDA-kNY</a></li> </ul>				
11-20	TB1, Chapter 2	<p><b>Bandpass signal to equivalent low pass:</b> Hilbert Transform, Pre-envelopes, Complexenvelopes, Canonical representation of bandpass signals, Complex low passrepresentation of band-pass systems, Complex representation of bandpass signals andsystems.</p> <p><b>Line codes:</b> Unipolar, Polar, Bipolar (AMI) and Manchester code and their powerspectral densities. Overview of HDB3, B3ZS, B6ZS.</p>	Chalk and Talk, Video Lectures	20
<b>Links to some useful online lectures:</b>				
<ul style="list-style-type: none"> <li>➤ <a href="https://www.youtube.com/watch?v=ITOWbmXtGeU&amp;t=623s">https://www.youtube.com/watch?v=ITOWbmXtGeU&amp;t=623s</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=yssVLZEyNis&amp;t=1082s">https://www.youtube.com/watch?v=yssVLZEyNis&amp;t=1082s</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=VyLU8hlhI-I">https://www.youtube.com/watch?v=VyLU8hlhI-I</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=ahLbJ66sc10">https://www.youtube.com/watch?v=ahLbJ66sc10</a></li> </ul>				
21-30	TB2, Chapter10	<p><b>Communication through Band Limited Channels:</b> Digital Transmission throughBand limited channels - Inter Symbol Interference, Eye diagrams, Signal design forBand limited ideal channel with zero ISI – Nyquist Criterion (statement only), Sinc andRaised pulse shaping.Signal design for Band limited channel with controlled ISI – Correlative coding, DB andMDB, Precoding.Basic Concepts of Equalization for non-ideal channels – ZFE, MMSE, (withoutderivations), Adaptive Equalizers (Block diagram only)</p>	Chalk and Talk, Video Lectures	20
<b>Links to some useful online lectures:</b>				
<ul style="list-style-type: none"> <li>➤ <a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/lecture-19-baseband-detection/">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/lecture-19-baseband-detection/</a></li> <li>➤ <a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-02-introduction-to-eecs-ii-digital-communication-systems-fall-2012/lecture-videos/lecture-10-linear-time-invariant-lti-systems/">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-02-introduction-to-eecs-ii-digital-communication-systems-fall-2012/lecture-videos/lecture-10-linear-time-invariant-lti-systems/</a></li> <li>➤ <a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-02-introduction-to-eecs-ii-digital-communication-systems-fall-2012/lecture-videos/lecture-9-transmitting-on-a-physical-channel/">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-02-introduction-to-eecs-ii-digital-communication-systems-fall-2012/lecture-videos/lecture-9-transmitting-on-a-physical-channel/</a></li> <li>➤ <a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-02-introduction-to-eecs-ii-digital-communication-systems-fall-2012/lecture-videos/lecture-11-lti-channel-and-intersymbol-interference/">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-02-introduction-to-eecs-ii-digital-communication-systems-fall-2012/lecture-videos/lecture-11-lti-channel-and-intersymbol-interference/</a></li> </ul>				

31-40	TB1, Chapter 7	<b>Signaling over AWGN channels:</b> Detection and Estimation Introduction, Geometric representation of signals, Gram-Schmidt Orthogonalization procedure, Conversion of the continuous AWGN channel into a vector channel, Optimum receivers using coherent detection: ML Decoding, Correlation receiver, matched filter receiver.	Chalk and Talk, Video Lectures	20
<b>Links to some useful online lectures:</b>				
<ul style="list-style-type: none"> <li>➤ <a href="https://www.youtube.com/watch?v=0hdgjfQ6YuU">https://www.youtube.com/watch?v=0hdgjfQ6YuU</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=2Q0yvxTGOjM">https://www.youtube.com/watch?v=2Q0yvxTGOjM</a></li> <li>➤ <a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/lecture-16-review-introduction-to-detection/">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/lecture-16-review-introduction-to-detection/</a></li> <li>➤ <a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/lecture-17-detection-for-random-vectors-and-processes/">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/lecture-17-detection-for-random-vectors-and-processes/</a></li> </ul>				
41-50	TB1, Chapter 7	<b>Digital Modulation Techniques:</b> Digital modulation formats, Phase shift Keying techniques using coherent detection: BPSK, QPSK generation, detection and error probabilities, M-ary PSK, M-ary QAM. Frequency shift keying techniques using Coherent detection: BFSK generation, detection and error probability.  <b>Non coherent orthogonal modulation techniques:</b> BFSK, DPSK Symbol representation, Block diagrams treatment of Transmitter and Receiver, Probability of error (Without derivation)	Chalk and Talk, Video Lectures	20
<b>Links to some useful online lectures:</b>				
<ul style="list-style-type: none"> <li>➤ <a href="https://www.youtube.com/watch?v=nMULaXNMhYI">https://www.youtube.com/watch?v=nMULaXNMhYI</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=HdmMY651Eek">https://www.youtube.com/watch?v=HdmMY651Eek</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=kusgZJGbXyM">https://www.youtube.com/watch?v=kusgZJGbXyM</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=go3tiuFFG08">https://www.youtube.com/watch?v=go3tiuFFG08</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=AOkR5AHp7H0">https://www.youtube.com/watch?v=AOkR5AHp7H0</a></li> </ul>				
51-60	TB2, Chapter 15	<b>Principles of Spread Spectrum:</b> Concept of Spread Spectrum, Direct Sequence/SS, Frequency Hopped SS, Processing Gain, Interference, and probability of error statement only. PN sequences for Spread Spectrum – M-sequences with Properties; Gold, Kasami sequences with basic properties. Direct sequence spread spectrum system concepts, Frequency Hopped Spread spectrum system concepts, Spread Spectrum Synchronization (block diagram treatment) - Code Acquisition and Tracking.	Chalk and Talk, Video Lectures	20

**Links to some useful online lectures:**

- <https://www.youtube.com/watch?v=ahLbJ66sc10>
- <https://www.youtube.com/watch?v=GrA46JJ0xbU>
- <https://www.youtube.com/watch?v=afCZ7nPlv78>

**Text Books**

1.	Simon Haykin, “Digital Communication Systems”, John Wiley & sons, First Edition, 2014, ISBN 978-0-471-64735-5.
2.	John G Proakis and MasoudSalehi, “Fundamentals of Communication Systems”, 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.

**Reference Books**

1.	B.P.Lathi and Zhi Ding, “Modern Digital and Analog communication Systems”, Oxford University Press, 4th Edition, 2010, ISBN: 978-0-198-07380-2.
2.	Ian A Glover and Peter M Grant, “Digital Communications”, Pearson Education, Third Edition, 2010, ISBN 978-0-273-71830-7.

**Syllabus for Internal Assessment Tests (IAT\*)**

IAT #	Syllabus
IAT-1	Lecture# 11–25
IAT-2	Lecture# 26–44
IAT-3	Lecture# 45 –60

\*See calendar of events for IAT schedule.

**Course Outcomes**

**By the end of this course, students will be able to**

- |    |   |
|----|---|
| 1. | explain the conversion of bandpass signal to equivalent low pass signal     |
| 2. | explain the principles of detection of known signals in a noisy environment |
| 3. | explain the various digital modulation techniques                           |
| 4. | explain the principles of communication through band-limited channels       |
| 5. | explain the principles of spread spectrum communication                     |

\*\*Based on table 01, 02, 03 in appendix, following are the Course outcomes.

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	explain the conversion of bandpass signal to equivalent low pass signal	1	3	3	0	0	0	0	0	0	1	0	0	0	0	3	0
CO2	explain the principles of detection of known signals in a noisy environment	2	3	3	0	0	0	0	0	0	1	0	0	0	0	3	0
CO3	explain the various digital modulation techniques	3	3	3	0	0	0	0	0	0	1	0	0	0	0	3	0

CO4	explain the principles of communication through band-limited channels	4	3	3	0	0	0	0	0	0	0	1	0	0	0	0	3	0
CO5	explain the principles of spread spectrum communication	5	3	3	0	0	0	0	0	0	0	1	0	0	0	0	3	0

**Note: Assignments, study material, Question bank and other course related content would be posted on site mentioned above.**

Signature with date:	Course Instructor	Program Coordinator	Head-TCE
----------------------	-------------------	---------------------	----------

## Appendix

Table 01: Cognitive Levels

Cognitive Levels	
Cognitive level	Revised Blooms Taxonomy Keywords
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.


Table 02: Program Outcomes (PO) and Program Specific Outcomes (PSO)

Program Outcomes (PO), Program Specific Outcomes (PSO)	
<b>PO1</b>	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
<b>PO2</b>	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
<b>PO3</b>	<b>Design/development of solutions:</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
<b>PO4</b>	<b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
<b>PO5</b>	<b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

<b>PO6</b>	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
<b>PO7</b>	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
<b>PO8</b>	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
<b>PO9</b>	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
<b>PO10</b>	<b>Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
<b>PO11</b>	<b>Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
<b>PO12</b>	<b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
<b>PSO1</b>	Apply principles of electrical and electronic circuit theory to the design and simulation of analog and digital circuits.
<b>PSO2</b>	Apply principles of mathematics, signal processing and communication theory to analyze different types of signals and to design communication systems.
<b>PSO3</b>	Take part in consultancy projects as an electronics design engineer and documentation and publication of reports.

Table 03: Correlation Levels

<b>Correlation Levels</b>	
<b>0</b>	No Correlation
<b>1</b>	Slight/Low
<b>2</b>	Moderate/ Medium
<b>3</b>	Substantial/ High

<b>CMR Institute of Technology, Bengaluru-560037</b>			
<b>Department of ECE/Telecommunication Engineering</b>			
<b>Semester</b>	VI	<b>Section</b>	A
<b>Subject</b>	<b>ARM MICROCONTROLLER &amp; EMBEDDED SYSTEM</b>	<b>Code</b>	15EC62
<b>Course Instructor</b>	Prof. Sophiya Susan, Prof Sudatta Mohanty, Prof Pushpa S		
<b>Course Duration</b>	29.01.2018 to 25.05.2018	<b>Total Number of Lecture Hours</b>	60
<b>IA Marks</b>	20	<b>Main Exam Marks</b>	80

<b>Course Objectives</b>
➤
<b>Prerequisites</b>
➤

<b>LESSON PLAN</b>			
<b>Lecture #</b>	<b>Topics</b>	<b>Books and Chapters</b>	<b>% of Syllabus Covered</b>
1-10	<b>ARM-32 bit Microcontroller:</b> Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, Debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence (Text 1: Ch 1, 2, 3)	Text 1: Ch 1, 2, 3	20%
<b>Links to some useful online lectures:</b>			
<a href="https://www.youtube.com/watch?v=o0ybJmyT2U">https://www.youtube.com/watch?v=o0ybJmyT2U</a> <a href="https://www.youtube.com/watch?v=x0gH5JGNIGg">https://www.youtube.com/watch?v=x0gH5JGNIGg</a>			

11-21	<p><b>ARM Cortex M3 Instruction Sets and Programming:</b> Assembly basics, Instruction list and description, useful instructions, Assembly and C language Programming</p>	Text1: Ch-4, Ch-5, Ch-10 (10.1, 10.2, 10.3, 10.5) only	20%
<p><b>Links to some useful online lectures:</b></p> <ul style="list-style-type: none"> <li>➤ <a href="https://www.youtube.com/watch?v=15z_vn4H41U&amp;list=PL77-op_SRaiF2xlcZKtEWqkB-5iuNBN5-">https://www.youtube.com/watch?v=15z_vn4H41U&amp;list=PL77-op_SRaiF2xlcZKtEWqkB-5iuNBN5-</a></li> </ul>			
22-31	<p><b>Embedded System Components:</b> Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of ES. Core of an Embedded System including all types of processor/controller, Memory, Sensors, Actuators, LED, 7 segment LED display, Optocoupler, relay, Piezo buzzer, Push button switch, Communication Interface (onboard and external types), Embedded firmware, Other system components.</p>	Text 2: All the Topics from Ch-2 and Ch-3, excluding 2.3 & 3.4 (stepper motor), 2.3 & 3.8 (keyboard) and 2.3 & 3.9 (PPI) sections).	20%
<p><b>Links to some useful online lectures:</b></p> <ul style="list-style-type: none"> <li>➤ <a href="https://www.youtube.com/watch?v=bsNvMc6JD1o">https://www.youtube.com/watch?v=bsNvMc6JD1o</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=oXqC0wFsNEI">https://www.youtube.com/watch?v=oXqC0wFsNEI</a></li> </ul>			
32-40	<p><b>Embedded System Design Concepts:</b> Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems-Application and Domain specific, Hardware Software Co-Design and Program Modelling (excluding UML), Embedded firmware design and development (excluding C language).</p>	(Text 2: Ch-3, Ch-4, Ch-7 (Sections 7.1, 7.2 only), Ch-9 (Sections 9.1, 9.2, 9.3.1, 9.3.2 only)	20%
<p><b>Links to some useful online lectures:</b></p> <ul style="list-style-type: none"> <li>➤ <a href="https://www.youtube.com/watch?v=8grRV-iBYts">https://www.youtube.com/watch?v=8grRV-iBYts</a></li> </ul>			



48-58	<p><b>RTOS and IDE for Embedded System Design:</b> Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, reemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment – Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques</p>	<p>(Text 2: Ch-10 (Sections 10.1, 10.2, 10.3, 10.5.2, 10.7, 10.8.1.1, 10.8.1.2, 10.8.2.2, 10.10 only), Ch 12, Ch-13 (a block diagram before 13.1, 13.3, 13.4, 13.5, 13.6 only)</p>	20%
<p><b>Links to some useful online lectures:</b>  ➤ <a href="https://www.youtube.com/watch?v=3V9eqvkMzHA">https://www.youtube.com/watch?v=3V9eqvkMzHA</a></p>			
58-60	<b>Revision</b>		

<b>Text Books</b>				
<b>Book Type</b>	<b>Code</b>	<b>Author &amp; Title</b>	<b>Publication info</b>	
			<b>Edition &amp; Publisher</b>	<b>ISBN #</b>
Text Book	TB	Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”,	2 <sup>nd</sup> Edition, Newnes, 2010.	
References	RB1	Shibu K V, “Introduction to Embedded Systems”,	Tata McGraw Hill Education Private Limited, 2009.	978-0-07-014589-4

**Portion for Internal Assessment Tests\***

<b>IAT#</b>	<b>Portion</b>
IAT-1	Lecture# 11–25
IAT-2	Lecture# 26–43
IAT-3	Lecture# 44 –60

\*See calendar of events for the schedules of IATs

### Course Outcomes

By the end of this course, students will be able to

- explain the conversion of bandpass signal to equivalent low pass signal (C601.1)
- explain the principles of detection of known signals in a noisy environment (C601.2)
- explain the various digital modulation techniques (C601.3)
- explain the principles of communication through band-limited channels (C601.4)
- explain the principles of spread spectrum communication (C601.5)

### COGNITIVE LEVELS

Cognitive level	REVISED BLOOMS TAXONOMY KEYWORDS
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

### Graduate Attributes/Program Outcomes (Defined by NBA)

POs	Program Outcome
<b>PO1</b>	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
<b>PO2</b>	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
<b>PO3</b>	<b>Design/development of solutions:</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
<b>PO4</b>	<b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
<b>PO5</b>	<b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

<b>PO6</b>	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
<b>PO7</b>	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
<b>PO8</b>	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
<b>PO9</b>	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
<b>PO10</b>	<b>Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
<b>PO11</b>	<b>Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
<b>PO12</b>	<b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### Program Specific Outcomes - Defined by Program – B.E.(TCE)


<b>PSOs</b>	<b>Program Specific Outcome</b>
PSO1	Apply principles of electrical and electronic circuit theory to the design and simulation of analog and digital circuits.
PSO2	Apply principles of mathematics, signal processing and communication theory to analyze different types of signals and to design communication systems.
PSO3	Take part in consultancy projects as an electronics design engineer and documentation and publication of reports.

### CORRELATION LEVELS

<b>0</b>	No Correlation
<b>1</b>	Slight/Low
<b>2</b>	Moderate/ Medium
<b>3</b>	Substantial/ High

### CO-PO & CO-PSO MAPPING

<b>Course Outcomes</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>C601.1</b>	3	3	0	0	0	0	0	0	1	0	0	0	0	3	0
<b>C601.2</b>	3	3	0	0	0	0	0	0	1	0	0	0	0	3	0
<b>C601.3</b>	3	3	0	0	0	0	0	0	1	0	0	0	0	3	0

CMR Institute of Technology, Bangalore																
Department: Telecommunication Engineering																
Semester: 06			Section: NA			Lectures/week: 04										
Subject: Microwave Theory and Antenna					Code: 15TE63											
Course Instructor: Abhishek Javali																
Course duration: 01 Jan 2018 – 25 May 2018																
Course Site: <a href="https://sites.google.com/a/cmrit.ac.in/abhishekjavali/">https://sites.google.com/a/cmrit.ac.in/abhishekjavali/</a>																
<b>C601.4</b>	3	3	0	0	0	0	0	0	0	1	0	0	0	0	3	0
<b>C601.5</b>	3	3	0	0	0	0	0	0	0	1	0	0	0	0	3	0

### Course Objectives

- To explain the generation of microwaves and study of these modes
- To explain the design of microwave transmission line, strip lines and study standing wave theory
- To explain the microwave network theory and study properties of s-parameters
- To explain the working principles of microwave passive devices and study of modelling these devices
- To explain fundamental antenna parameters
- To explain point sources, power theorem, fields from short dipole
- To explain the different antennas such as loop, horn, helix etc.

### Prerequisites

- Basics of electromagnetics
- Transmission line theory
- Two port modelling parameters such as Z-parameters, Y-parameters, hybrid parameters etc.,

<b>Lesson Plan</b>				
Lecture #	Book & Sections	Topics	Portions coverage	
			Teaching Aids	% of Syllabus Covered
1-10	TB1: 9.1 to 9.2.2, TB2: 3.1, 3.2, 3.3, 3.5, 3.6 Except Double stub matching	<b>Module-1</b> <b>Microwave Tubes:</b> Introduction, Reflex Klystron Oscillator, Mechanism of Oscillations, Modes of Oscillations, Mode Curve (Qualitative Analysis only). <b>(Text 1: 9.1, 9.2.2)</b> <b>Microwave Transmission Lines:</b> Transmission Line equations and solutions, Reflection Coefficient and Transmission Coefficient, Standing Wave and Standing Wave Ratio, Smith Chart, Single Stub matching. <b>(Text 2: 3.1, 3.2, 3.3, 3.5, 3.6 Except Double stub matching)</b>	Chalk and Talk Video Lectures for some topics	20
<b>Links to some useful online lectures:</b> <ul style="list-style-type: none"> <li>➤ <a href="https://www.youtube.com/watch?v=yPpreB0_6cA">https://www.youtube.com/watch?v=yPpreB0_6cA</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=surDm-x5Uwo">https://www.youtube.com/watch?v=surDm-x5Uwo</a></li> </ul>				
11-20	TB1 6.1-6.3 6.4.2, 6.4.14, 6.4.15, 6.4.16 Except Applications of Magic TEE, 6.4.17 TB2:4.5,4.5.1,4.5.2	<b>Module-2</b> <b>Microwave Network theory:</b> Symmetrical Z and Y-Parameters for Reciprocal Networks, S matrix representation of Multi-Port Networks. <b>(Text 1: 6.1, 6.2, 6.3)</b> <b>Microwave Passive Devices:</b> Coaxial Connectors and Adapters, Attenuators, Phase Shifters, Waveguide Tees, Magic tees, Circulators (Four port) and Isolators (Faraday Rotation Isolator). <b>(Text1: 6.4.2, 6.4.14, 6.4.15, 6.4.16 Except Applications of Magic TEE, 6.4.17)</b> <b>Directional Coupler,</b> Two - Hole Directional coupler, S- Matrix of a Directional Coupler. <b>(Text 2: 4.5,4.5.1,4.5.2)</b>	Chalk and Talk Video Lectures for some topics	20
<b>Links to some useful online lectures:</b> <ul style="list-style-type: none"> <li>➤ <a href="https://www.youtube.com/watch?v=e8TOglXYGCI">https://www.youtube.com/watch?v=e8TOglXYGCI</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=58XeDldVWtQ">https://www.youtube.com/watch?v=58XeDldVWtQ</a></li> </ul>				
21-30	TB2 Ch11,	<b>Module-3</b>	Chalk and Talk	20

	TB3:2.1- 2.11, 2.13,2.15	<b>Strip Lines:</b> Introduction, Micro Strip lines, Parallel strip lines, Coplanar strip lines, Shielded strip Lines. <b>(Text 2: Chapter 11)</b> <b>Antenna Basics:</b> Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity and Gain, Antenna Apertures, Effective Height, Radio Communication Link, Antenna Field Zones & Polarization. <b>(Text 3: 2.1- 2.11, 2.13,2.15)</b>	Video Lectures for some topics	
--	-----------------------------	--	--------------------------------	--

**Links to some useful online lectures:**

- [https://www.youtube.com/watch?v=XPRELuPI\\_04](https://www.youtube.com/watch?v=XPRELuPI_04)
- [https://www.youtube.com/watch?v=wx\\_tIvaajAI&list=PLzJaFd3A7DZsL9dZDCeA3ijHZwwBb6R8y](https://www.youtube.com/watch?v=wx_tIvaajAI&list=PLzJaFd3A7DZsL9dZDCeA3ijHZwwBb6R8y)

31-40	TB3 5.1 – 5.9, 5.11,5.13- 5.15 TB3:6.1-6.6	<b>Module-4</b> <b>Point Sources and Arrays:</b> Introduction, Point Sources, Power Patterns, Power Theorem, Radiation Intensity, Field Patterns, Phase Patterns, Arrays of Two Isotropic Point Sources, Pattern Multiplication, Linear Arrays of n Isotropic Point Sources of equal Amplitude and Spacing. <b>(Text 3: 5.1 – 5.9, 5.11,5.13- 5.15)</b> <b>Electric Dipoles:</b> Introduction, Short Electric Dipole, Fields of a Short Dipole (General and Far Field Analyses), Radiation Resistance of a Short Dipole, Thin Linear Antenna (Field Analyses), Radiation Resistances of Lambda/2 Antenna. <b>(Text 3: 6.1 -6.6)</b>	Chalk and Talk Video Lectures for some topics	20
-------	---	---	--	----

**Links to some useful online lectures:**

- <https://www.youtube.com/watch?v=R3pvUbpFA4k>
- <https://www.youtube.com/watch?v=eiVrfq10BFE&t=8s>

41-50	TB3 7.1-7.8, 7.19, 7.20 TB3: 8.3,8.5, 8.8,9.5,11.7	<b>Module-5</b> <b>Loop and Horn Antenna:</b> Introduction, Small loop, Comparison of Far fields of Small Loop and Short Dipole, The Loop Antenna General Case , Far field Patterns of Circular Loop Antenna with Uniform Current, Radiation Resistance of Loops, Directivity of Circular Loop Antennas with Uniform Current, Horn antennas Rectangular Horn Antennas <b>(Text 3: 7.1-7.8, 7.19, 7.20)</b> <b>Antenna Types:</b> Helical Antenna, Helical Geometry, Practical Design Considerations of Helical Antenna, Yagi-Uda array, Parabola General Properties, Log Periodic	Chalk and Talk Video Lectures for some topics	20
-------	---	---	--	----

	Antenna. (Text 3: 8.3,8.5, 8.8,9.5,11.7)	
<b>Links to some useful online lectures:</b>		
➤	<a href="https://www.youtube.com/watch?v=jA8aTA1Pg4s&amp;list=PLCcWs0lpRgKcOu8LAX7GIZLIAHgyN1oVS">https://www.youtube.com/watch?v=jA8aTA1Pg4s&amp;list=PLCcWs0lpRgKcOu8LAX7GIZLIAHgyN1oVS</a>	
➤	<a href="https://www.youtube.com/watch?v=jA8aTA1Pg4s&amp;list=PLCcWs0lpRgKcOu8LAX7GIZLIAHgyN1oVS">https://www.youtube.com/watch?v=jA8aTA1Pg4s&amp;list=PLCcWs0lpRgKcOu8LAX7GIZLIAHgyN1oVS</a>	

<b>Text Books</b>	
1.	<b>Microwave Engineering</b> – Annapurna Das, Sisir K Das TMH Publication, 2 <sup>nd</sup> , 2010.
2.	<b>Microwave Devices and circuits-</b> Liao / Pearson Education
3.	<b>Antennas and Wave Propagation</b> , John D. Krauss, Ronald J Marhefka and Ahmad S Khan, 4 <sup>th</sup> Special Indian Edition, McGraw- Hill Education Pvt. Ltd., 2010.
<b>Reference Books</b>	
3.	<b>Microwave Engineering</b> – David M Pozar, John Wiley India Pvt.Ltd. 3 <sup>rd</sup> Edn, 2008.
4.	<b>Microwave Engineering</b> – Sushrut Das, Oxford Higher Education, 2 <sup>nd</sup> Edn, 2015.
5.	<b>Antennas and Wave Propagation</b> – Harish and Sachidananda: Oxford University Press, 2007.

**Syllabus for Internal Assessment Tests (IAT\*)**

IAT #	Syllabus
IAT-1	Class # 01 – 20
IAT-2	Class # 21-35
IAT-3	Class # 35–50

\*See calendar of events for IAT schedule.

<b>Course Outcomes</b>
<b>By the end of this course, students will be able to</b>
1. explain the generation of microwaves and design microwave transmission line
2. explain the microwave network theory and explain microwave passive devices
3. explain the fundamental antenna parameters
4. explain the principles of point sources and electric dipole and its fields
5. explain the different types of antennas

\*\*Based on table 01, 02, 03 in appendix, following are the Course outcomes.

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	explain the generation of microwaves and design microwave transmission line	1	3	2	0	0	0	0	0	0	0	0	0	0	0	3	0
CO2	explain the microwave network theory and explain microwave passive devices	2	3	2	0	0	0	0	0	0	0	0	0	0	0	3	0
CO3	explain the fundamental antenna parameters	3	3	2	0	0	0	0	0	0	0	0	0	0	0	3	0
CO4	explain the principles of point sources and electric dipole and its fields	4	3	2	0	0	0	0	0	0	0	0	0	0	0	3	0
CO5	explain the different types of antennas	5	3	2	0	0	0	0	0	0	0	0	0	0	0	3	0

**Note: Assignments, study material, Question bank and other course related content would be posted on site mentioned above.**

Signature with date: | **Course Instructor**                      **Program Coordinator**                      **Head-TCE**

## Appendix

Table 01: Cognitive Levels

Cognitive Levels	
Cognitive level	Revised Blooms Taxonomy Keywords
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

Table 02: Program Outcomes (PO) and Program Specific Outcomes (PSO)


Program Outcomes (PO), Program Specific Outcomes (PSO)	
<b>PO1</b>	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.



<b>PO2</b>	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
<b>PO3</b>	<b>Design/development of solutions:</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
<b>PO4</b>	<b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
<b>PO5</b>	<b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
<b>PO6</b>	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
<b>PO7</b>	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
<b>PO8</b>	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
<b>PO9</b>	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
<b>PO10</b>	<b>Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
<b>PO11</b>	<b>Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
<b>PO12</b>	<b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
<b>PSO1</b>	Apply principles of electrical and electronic circuit theory to the design and simulation of analog and digital circuits.
<b>PSO2</b>	Apply principles of mathematics, signal processing and communication theory to analyze different types of signals and to design communication systems.
<b>PSO3</b>	Take part in consultancy projects as an electronics design engineer and documentation and publication of reports.

Table 03: Correlation Levels

<b>Correlation Levels</b>	
<b>0</b>	No Correlation
<b>1</b>	Slight/Low
<b>2</b>	Moderate/ Medium
<b>3</b>	Substantial/ High

CMR Institute of Technology, Bangalore		
Department(s): Telecommunication Engineering		
Semester: 06	Section(s): A	
Computer Communication Networks	15EC64	Lectures/week: 04
Course Instructor(s): Prof Sharmila.K.P		
Course duration: 05 Feb., 2018 – 25 May 2018		

### Course Objectives

- Have a good understanding of the OSI Reference Model and TCP/IP model.
- Understand and select the most appropriate networking architecture and technologies.
- Have an fair understanding of the issues surrounding wired and Wireless Networks..
- Specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols
- Identify the different types of network devices and their functions within a network.

- To be familiar with network tools and network programming

### Prerequisites

- Basic concepts of data communication.
- Basic terminology used in computer networking area.
- Basic knowledge of networking tools.

### LESSON PLAN

Lecture #	Book & Sections	Topics	Portions coverage	
			Teaching Aids	% of Syllabus Covered
1-10	TB1: - 1.1-1.3, 9.1-9.2 11.2-11.2	<p><b>Module – 1 INTRODUCTION:</b> Data Communications: Components, Representations, Data Flow, Networks: Physical Structures, Network Types: LAN, WAN, Switching, Internet.</p> <p><b>Network Models:</b> Protocol Layering: Scenarios, Principles, Logical Connections, TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI Model: OSI Versus TCP/IP.</p> <p><b>Data-Link Layer:</b> Introduction: Nodes and Links, Services, Categories' of link, Sublayers, Link Layer addressing: Types of addresses, ARP. Data Link Control (DLC) services: Framing, Flow and Error Control, Data Link Layer Protocols: Simple Protocol, Stop and Wait protocol, Piggybacking.</p>	Chalk and Talk  Video Lectures for some topics  PPTs	20
<p><b>Links to some useful online lectures:</b></p> <ul style="list-style-type: none"> <li>➤ <a href="https://www.youtube.com/watch?v=l_OPR2yh2co">https://www.youtube.com/watch?v=l_OPR2yh2co</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=pVI1L1jrbFE">https://www.youtube.com/watch?v=pVI1L1jrbFE</a></li> </ul>				
11-16	TB1 12.1-12.21.2 13.1-13.5	<p><b>Module-2 -Media Access Control:</b> Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. Controlled Access: Reservation, Polling, Token Passing.</p> <p><b>Wired LANs: Ethernet:</b> Ethernet Protocol: IEEE802, Ethernet Evolution, Standard Ethernet: Characteristics, Addressing, Access Method, Efficiency, Implementation, Fast Ethernet: Access Method, Physical Layer, Gigabit Ethernet: MAC Sublayer, Physical Layer, 10 Gigabit Ethernet.</p>	Chalk and Talk  Video Lectures for some topics  PPTs	20
<p><b>Links to some useful online lectures:</b></p> <ul style="list-style-type: none"> <li>➤ <a href="https://www.youtube.com/watch?v=QhKIaK4ReUA">https://www.youtube.com/watch?v=QhKIaK4ReUA</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=KDHbP81SAmA">https://www.youtube.com/watch?v=KDHbP81SAmA</a></li> </ul>				
17-27	TB1 15.1 - 15.3 17.1-17.2 18.1-18.5	<p><b>Module 3- Wireless LANs:</b> Introduction: Architectural Comparison, Characteristics, IEEE 802.11: Architecture, MAC sublayer, Addressing Mechanism, Physical Layer, Bluetooth: Architecture, Layers.</p> <p><b>Connecting Devices:</b> Hubs, Switches, <b>Virtual LANs:</b> Membership, Configuration, Communication between Switches, Advantages.</p>	Chalk and Talk  PPTs	20

		<b>Network Layer:</b> Introduction, Network Layer services: Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses: Address Space, Classful Addressing, Classless Addressing, DHCP, Network Address Resolution, Forwarding of IP Packets: Based on destination Address and Label..		
--	--	--	--	--

**Links to some useful online lectures:**

- <https://www.youtube.com/watch?v=WcMoZ2VUyfU>
- <https://www.youtube.com/watch?v=x51RYJ5KsU4>
- <https://www.youtube.com/watch?v=wbp5DDSCrUw>

28-40	TB1 19.1-19.3 20.1-20.3	<b>Module 4- Network Layer Protocols:</b> Internet Protocol (IP): Datagram Format, Fragmentation, Options, Security of IPv4 Datagrams, ICMPv4: Messages, Debugging Tools, Mobile IP: Addressing, Agents, Three Phases, Inefficiency in Mobile IP. <b>Unicast Routing:</b> Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing, Path vector routing, Unicast Routing Protocol: Internet Structure, Routing Information Protocol, Open Shortest Path First, Border Gateway Protocol Version 4.	Chalk and Talk  Video Lectures for some topics	20
-------	-------------------------------	---	--	----

**Links to some useful online lectures:**

- [https://www.youtube.com/watch?v=z\\_ICsUGwr3U](https://www.youtube.com/watch?v=z_ICsUGwr3U)
- <https://www.youtube.com/watch?v=601x64peZtU>
- <https://www.youtube.com/watch?v=AmlOSGYkKXc&index=26&list=PLCB46B39EBE51B674>

41-51	TB1 23.1-23.2 24.1-24.3	<b>Module 5 -Transport Layer:</b> Introduction: Transport Layer Services, Connectionless and Connection oriented Protocols, Transport Layer Protocols: Simple protocol, Stop and wait protocol, Go-Back-N Protocol, Selective repeat protocol, User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, Connection, State Transition diagram, Windows in TCP, Flow control, Error control, TCP congestion control.	Chalk and Talk  PPTs	20
-------	-------------------------------	--	----------------------------	----

**Links to some useful online lectures:**

- <https://www.youtube.com/watch?v=qdlYJ-Wa8i8>
- [https://www.youtube.com/watch?v=z\\_ICsUGwr3U&t=59s](https://www.youtube.com/watch?v=z_ICsUGwr3U&t=59s)

<b>Text Books</b>	
1.	Data Communications and Networking , Forouzan, 5th Edition, McGraw Hill, 2016 ISBN: 1-25-906475-3
<b>Reference Books</b>	
6.	Computer Networks, James J Kurose, Keith W Ross, Pearson Education, 2013, ISBN: 0-273-76896-4
7.	Introduction to Data Communication and Networking, Wayarles Tomasi, Pearson Education, 2007, ISBN:0130138282

IAT #	Syllabus
IAT-1	Class # 01 – 18
IAT-2	Class # 19– 37
IAT-3	Class # 38– 51

\* : See calendar of events for the schedules of IATs.

### Course Outcomes

**By the end of this course, students will be able to**

1. Describe, analyze and compare the OSI reference model and TCP/IP model.
2. Demonstrate the students with basic protocols used in wired and wireless LAN.
8. To be familiar with the skills of subnet-ting and routing mechanism by connecting networking devices using IPV4.
9. Solve the issues related with networking like congestion control etc.

### COGNITIVE LEVELS

Cognitive level	REVISED BLOOMS TAXONOMY KEYWORDS
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

### PROGRAM OUTCOMES (PO), PROGRAM SPECIFIC OUTCOMES (PSO)

<b>PO1</b>	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
<b>PO2</b>	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
<b>PO3</b>	<b>Design/development of solutions:</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.


<b>PO4</b>	<b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
<b>PO5</b>	<b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
<b>PO6</b>	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
<b>PO7</b>	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
<b>PO8</b>	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
<b>PO9</b>	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
<b>PO10</b>	<b>Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
<b>PO11</b>	<b>Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
<b>PO12</b>	<b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
<b>PSO 1</b>	Apply principles of electrical and electronic circuit theory to the design and simulation of analog and digital circuits.
<b>PSO 2</b>	Apply principles of mathematics, signal processing and communication theory to analyze different types of signals and to design communication systems.
<b>PSO 3</b>	Take part in consultancy projects as an electronics design engineer and documentation and publication of reports.

### CORRELATION LEVELS

<b>0</b>	No Correlation
<b>1</b>	Slight/Low
<b>2</b>	Moderate/ Medium
<b>3</b>	Substantial/ High

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	Describe, analyze and compare the OSI reference model and TCP/IP model	1	3	-	-	-	2	-	-	-	1	1	-	2	-	1	-	-
CO2	Introduce the students with basic protocols used in wired and wireless LAN.	2,3	3	2	2	2	2	-	-	-	1	1	-	2	-	1	-	-
CO3	To be familiar with the skills of subnetting and routing mechanism by connecting networking devices using IPV4	3,4	3	2	-	2	2	-	-	-	1	1	-	2	-	1	-	-
CO4	Solve the issues related with networking like congestion control etc.	5	3	2	-	2	2	-	-	-	1	1	-	2	-	1	-	-

Note : From time to time, assignments will be posted on <https://sites.google.com/a/cmrit.ac.in/sharmila-k-p/home>

CMR Institute of Technology, Bangalore		
Department(s): Department of Telecommunication Engineering		
Semester: 06	Section(s):	
Image Processing	15TE655	Lectures/week: 04
Course Instructor(s): Prof. Shruthi M L J		
Course duration: 01 Jan., 2018 – 25 May 2018		

### Course Objectives

- To explain the basic concepts of digital image processing
- To explain the current techniques used in intensity transformations and spatial filtering
- To describe how the fourier transform and frequency domain can be used for image filtering
- To explain the concepts of morphological processing, periodic noise reduction and image segmentation
- To explain the concepts of region based segmentation, thresholding

### Prerequisites

- Basics concepts of Digital image, video, pixel

➤ Fourier Transform

**LESSON PLAN**

Lecture #	Book & Sections	Topics	Portions coverage	
			Teaching Aids	% of Syllabus Covered
1-3		<b>Basics of Image Processing:</b> Concept of Digital Image, video, pixel. Why digital image processing? A brief overview of matlab.	Chalk and Talk  Video Lectures for some topics	
<b>Links to some useful online lectures:</b> <ul style="list-style-type: none"> <li>➤ <a href="https://www.youtube.com/watch?v=KEGQT48P-WU">https://www.youtube.com/watch?v=KEGQT48P-WU</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=uWYudnCwiEE">https://www.youtube.com/watch?v=uWYudnCwiEE</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=CVV0TvNK6pk">https://www.youtube.com/watch?v=CVV0TvNK6pk</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=uJvqbZtGih4">https://www.youtube.com/watch?v=uJvqbZtGih4</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=aOuCpbD9O_c">https://www.youtube.com/watch?v=aOuCpbD9O_c</a></li> </ul>				
4-6	TB1, Chapter 1	<b>UNIT 1 - Introduction:</b> What is Digital Image Processing, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing system.	Chalk and Talk  Video Lectures for some topics	5
<b>Links to some useful online lectures:</b> <ul style="list-style-type: none"> <li>➤ <a href="https://www.youtube.com/watch?v=uJvqbZtGih4">https://www.youtube.com/watch?v=uJvqbZtGih4</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=6dFnpz_AEYyA">https://www.youtube.com/watch?v=6dFnpz_AEYyA</a></li> <li>➤ <a href="https://sisu.ut.ee/imageprocessing/book/1">https://sisu.ut.ee/imageprocessing/book/1</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=sCrfqIWMDzl">https://www.youtube.com/watch?v=sCrfqIWMDzl</a></li> </ul>				
7-11	TB1 2.1 – 2.5	<b>UNIT 2- Digital Image Fundamentals:</b> Elements of Visual Perception, A Simple Image Formation Model, Basic Concepts in Sampling and Quantization, Representing Digital Images, Spatial and Intensity Resolution, Some Basic Relationships Between Pixels.	Chalk and Talk	15
<b>Links to some useful online lectures:</b> <ul style="list-style-type: none"> <li>➤ <a href="https://www.youtube.com/watch?v=sCrfqIWMDzl">https://www.youtube.com/watch?v=sCrfqIWMDzl</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=K4UUF9srsu8">https://www.youtube.com/watch?v=K4UUF9srsu8</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=bJvv5SckGeA">https://www.youtube.com/watch?v=bJvv5SckGeA</a></li> </ul>				
12-20	TB1 3.1 – 3.6	<b>UNIT 3- Image Enhancement in the Spatial Domain:</b> Background, Some Basic Intensity Transformation Functions, Histogram Processing,	Chalk and Talk	20



		Enhancement Using Arithmetic/Logic Operations, Fundamentals of Spatial Filtering, Smoothing and sharpening Spatial Filters.	Video Lectures for some topics	
<b>Links to some useful online lectures:</b>				
<ul style="list-style-type: none"> <li>➤ <a href="https://www.youtube.com/watch?v=994ZNi7rSXo">https://www.youtube.com/watch?v=994ZNi7rSXo</a></li> <li>➤ <a href="https://www.coursera.org/learn/digital/.../histogram-processing">https://www.coursera.org/learn/digital/.../histogram-processing</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=nIRhHb04u_k">https://www.youtube.com/watch?v=nIRhHb04u_k</a></li> <li>➤ <a href="https://www.youtube.com/watch?v=qKWPBzRD-U0">https://www.youtube.com/watch?v=qKWPBzRD-U0</a></li> </ul>				
21-29	TB1 4.2, 4.4 to 4.7, 4.9.6, 5.2, 5.3	<b>UNIT 4 - Filtering, Image Restoration:</b> Preliminary Concepts, The Discrete Fourier Transform (DFT) of One Variable, Extension to Functions of Two Variables, Some Properties of the 2-D Discrete Fourier Transform, Frequency Domain Filtering, A Model of the Image degradation/Restoration process, Noise Models, Restoration in the Presence of Noise Only–Spatial Filtering, homomorphic filtering.	Chalk and Talk	20
<b>Links to some useful online lectures:</b>				
<ul style="list-style-type: none"> <li>➤ <a href="http://freevideolectures.com/Course/2316/Digital-Image-Processing-IIT-Kharagpur">http://freevideolectures.com/Course/2316/Digital-Image-Processing-IIT-Kharagpur</a></li> <li>➤ <a href="http://freevideolectures.com/Course/2316/Digital-Image-Processing-IIT-Kharagpur/22">http://freevideolectures.com/Course/2316/Digital-Image-Processing-IIT-Kharagpur/22</a></li> </ul>				
30-41	TB1 5.4 to 5.7, 9.1 to 9.5, 10.1, 10.2.2 to 10.2.5	<b>UNIT 5 –Periodic Noise Reduction:</b> Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering  <b>Morphological Image Processing:</b> Preliminaries, Dilation and Erosion, Opening and Closing, The Hit-or-Miss Transformation, Some Basic Morphological Algorithms.  <b>Image Segmentation:</b> Fundamentals, Point, Line and Edge Detection- Detection of isolated points, Line Detection, Edge Models, Basic Edge Detection	Chalk and Talk	20
<b>Links to some useful online lectures:</b>				
<ul style="list-style-type: none"> <li>➤ <a href="https://www.youtube.com/watch?v=KJnAy6hzetw">https://www.youtube.com/watch?v=KJnAy6hzetw</a> <a href="http://freevideolectures.com/Course/2316/Digital-Image-Processing-IIT-Kharagpur/22">http://freevideolectures.com/Course/2316/Digital-Image-Processing-IIT-Kharagpur/22</a></li> </ul>				
42-52	TB1 10.3, 10.4, 11.1	<b>UNIT - 6 - Image Segmentation and Representation:</b> Thresholding, Region-Based Segmentation, Boundary Following, Chain Codes, Polygonal Approximations using Minimum-Perimeter Polygons, Other Polygonal Approximation Approaches, Signature, Boundary Segmentations.	Chalk and Talk	20

**Links to some useful online lectures:**

- <https://www.youtube.com/watch?v=ahLbJ66sc10>
- <https://www.youtube.com/watch?v=uJvqbZtG1h4>

**Text Books**

1. **Digital Image Processing**-Rafel C Gonzalez and Richard E. Woods, PHI 3<sup>rd</sup> Edition 2010

**Reference Books**

10. **Digital Image Processing**-S.Jayaraman, S.Esakkirajan, T.Veerakumar, Tata McGraw Hill, 2014.
11. **Fundamentals of Digital Image Processing**-A. K. Jain, Pearson, 2004.

**Syllabus for Internal Assessment Tests (IAT) \***

IAT #	Syllabus
IAT-1	Class # 4– 20
IAT-2	Class # 21 – 34
IAT-3	Class # 35 – 52

\* : See calendar of events for the schedules of IATs.

**Course Outcomes**

**By the end of this course, students will be able to**

- explain the basic concepts of digital image processing (C605.1)
- explain the current techniques used in intensity transformations and spatial filtering (C605.2)
- describe how the fourier transform and frequency domain can be used for image filtering (C605.3)
- explain the concepts of morphological processing, periodic noise reduction and image segmentation(C605.4)
- explain the concepts of region based segmentation, thresholding (C605.5)

**COGNITIVE LEVELS**

Cognitive level	REVISED BLOOMS TAXONOMY KEYWORDS
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.

L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.
----	---

<b>Graduate Attributes/Program Outcomes (Defined by NBA)</b>	
<b>POs</b>	<b>Program Outcome</b>
<b>PO1</b>	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
<b>PO2</b>	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
<b>PO3</b>	<b>Design/development of solutions:</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
<b>PO4</b>	<b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
<b>PO5</b>	<b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
<b>PO6</b>	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
<b>PO7</b>	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
<b>PO8</b>	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
<b>PO9</b>	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
<b>PO10</b>	<b>Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
<b>PO11</b>	<b>Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
<b>PO12</b>	<b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### CORRELATION LEVELS

<b>0</b>	No Correlation
<b>1</b>	Slight/Low
<b>2</b>	Moderate/ Medium
<b>3</b>	Substantial/ High

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	Explain the basic concepts of digital image processing	1	3	3	-	-	-	-	-	-	1	-	-	-	-	3	-	-
CO2	Explain the current techniques used in intensity transformations and spatial filtering	2	3	3	-	-	-	-	-	-	1	-	-	-	-	3	-	-
CO3	Describe how the fourier transform and frequency domain can be used for image filtering	3	3	3	-	-	-	-	-	-	1	-	-	-	-	3	-	-
CO4	Explain the concepts of morphological processing, periodic noise reduction and image segmentation	4	3	3	-	-	-	-	-	-	1	-	-	-	-	3	-	-
CO5	Explain the concepts of region based segmentation, thresholding	5	3	3	-	-	-	-	-	-	1	-	-	-	-	3	-	-

Note : From time to time, assignments will be posted on

<https://sites.google.com/a/cmrit.ac.in/shruthi>