



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

## ELECTRONICS & COMMUNICATIONS ENGINEERING

### COURSE DESCRIPTION FORM

Course Title	:	CELLULAR AND MOBILE COMMUNICATIONS			
Course Code	:	A70434- R15			
Academic Year	:	2018 – 2019			
Branch	:	IV - B. Tech I Sem-ECE			
Course Structure	:	Lectures	Tutorials	Practicals	Credits
		3	1	--	3
Course Coordinator	:	Dr. P.G. Krishna Mohan, Professor, ECE Dept			
Team of Instructors	:	Mr. U Somanaidu, Assistant Professor, ECE Dept Mr. Shashikanth Reddy, Assistant Professor, ECE Dept			

#### I. COURSE OVERVIEW:

This course introduces the fundamentals of mobile communications that are important to wireless communication system. It introduces cellular mobile radio systems, various generations of cellular systems and fading channel. It also covers various types of interferences that are co-channel and non co-channel interferences in mobile radio environment. Subsequently the course describes cell coverage for signal and traffic, signal reflections in various terrains, various cell sites antennas & mobile antennas and their analysis. Next different frequency management and channel assignment techniques are described. Finally the concepts of handoffs, dropped calls and cell splitting are analyzed.

#### II. PREREQUISITE(S):

Level	Credits	Periods / Week	Prerequisites
UG	4	4	Analog communications & Digital communications

#### III. MARKS DISTRIBUTION:

Sessional Marks	University End Exam Marks	Total Marks
There shall be 2 midterm examinations. Each midterm examination consists of subjective test and objective test. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each subject shall contain 4 questions; the student has to answer any 2 questions, each carrying 5 marks. The objective test is for 10 marks, with duration of 20 min. First midterm examination shall be conducted for the first two and half units of syllabus and second midterm examination shall be conducted for the remaining portion. Five marks are marked for assignments. There shall be two assignments in every theory course. First assignment marks will be allotted to 1st mid for first two and half units and second assignment marks will be allotted to 2nd mid for the remaining portion. So each mid exam is conducted for 25 marks.	75	100

#### IV. EVALUATION SCHEME:

Sl.No	Component	Duration(Hrs)	Marks
1	I Mid Examination	1 hr 20 min	20
2	I Assignment	--	05
3	II Mid Examination	1 hr 20 min	20
4	II Assignment	--	05
5	End Semester Examination	3 hrs	75

#### V. COURSE OBJECTIVES:

**At the end of the course, the students will be able:**

- i. Understand the cellular concepts, frequency reuse, Hand-off strategies.
- ii. Analyze and understand wireless and mobile cellular communication system over a stochastic fading channel
- iii. Remember the co-channel and non co-channel interferences
- iv. Remember the cell coverage for signal and traffic, diversity techniques and mobile antennas.
- v. Understanding of frequency management, channel assignment and types of handoff.

#### VI. COURSE OUTCOMES:

**At the end of the course, the students will be able to:**

1. Identify the limitations of conventional Mobile Telephone Systems; understand the basic cellular mobile system.
2. Understand the concept of frequency Reuse channels, Deduce the Co-channel interference reduction factor.
3. Remember Uniqueness of mobile radio environment- fading- Factors Time dispersion parameters, Coherence bandwidth, Doppler spread and coherence time
4. Explain Co-channel interference with near end far end interference.
5. Explain adjacent channel interference, near end far end interference and UHF TV interference.
6. Remember concepts of cell coverage for signal and traffic.
7. Understand Signal reflections in flat and hilly terrain, Effect of human made structures, Phase difference between direct and reflected path
8. Understand cell site and mobile antennas.
9. Understand frequency management and channel assignment strategies.
10. Understand Cell Site And Mobile Antennas.
11. Define Handoff, Distinguish types of handoffs and evaluation of dropped call rates.
12. Understand the Frequency Management And Channel Assignment.
13. Remember Numbering and grouping, Setup access and paging channels, Channel assignments to cell sites
14. Channel sharing and barrowing, Sectorization, Channel assignments to cell sites in mobile communications.
15. Understand Types of handoff, Delaying handoff, Advantages of handoff, Power difference handoff.

#### VII. HOW PROGRAM OUTCOMES ARE ASSESSED:

<b>Program Outcomes</b>		<b>Level</b>	<b>Proficiency assessed by</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.	H	Assignments, Tutorials
<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.	H	Assignments
<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.	S	Mini Projects
<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.	H	Projects
<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.	S	Discussions
<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.	N	--
<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.	N	--
<b>PO8</b>	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	N	--
<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.	N	--
<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.	S	Presentations
<b>PO11</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.	H	Development of Prototype, Projects
<b>PO12</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.	S	Seminars, Discussions

#### **VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:**

Program Specific Outcomes		Level	Proficiency assessed by
<b>PSO1</b>	<b>Professional Skills:</b> An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc, in the design and implementation of Complex systems.	H	Lectures, Assignments
<b>PSO2</b>	<b>Problem-solving skills:</b> An ability to solve complex Electronics and communication Engineering problems, using latest hardware and Software tools, along with analytical skills to arrive cost effective and appropriate solutions.	S	Tutorials
<b>PSO3</b>	<b>Successful career and Entrepreneurship:</b> An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-World applications using optimal resources as an Entrepreneur.	S	Seminars and Projects

N - None

S - Supportive

H- Highly Related

## IX. SYLLABUS:

### UNIT - I

**INTRODUCTION TO CELLULAR MOBILE RADIO SYSTEMS:** Limitations of conventional mobile telephone systems, Basic Cellular Mobile System, First, second, third, and fourth generation cellular wireless systems, Uniqueness of mobile radio environment- fading- Factors Time dispersion parameters, Coherence bandwidth, Doppler spread and coherence time

**FUNDAMENTALS OF CELLULAR RADIO SYSTEM DESIGN:** Concept of frequency reuse, Co-channel interference, co-channel interference reduction factor, Desired C/I from a normal case in a Omni-directional antenna system, system capacity, trunking and grade of service, Improving coverage and capacity in cellular systems- Cell splitting, Sectoring, Microcell zone concept.

### UNIT - II

**CO-CHANNEL INTERFERENCE:** Measurement of real time Co-channel interference, Design of antenna system, Antenna parameters and their effects, Diversity technique- Space diversity, Polarization diversity, Frequency diversity, Time diversity.

**NON CO-CHANNEL INTERFERENCE:** Adjacent channel interference, Near end far end interference, cross talk, Effects on coverage and interference by power decrease, Antenna height decrease, Effects of cell site components.

### UNIT – III

**CELL COVERAGE FOR SIGNAL AND TRAFFIC:** Signal reflections in flat and hilly terrain, Effect of human made structures, Phase difference between direct and reflected path, constant standard deviation, Straight line path loss slope, General formula for mobile propagation over water and flat open area, Near and long distance propagation, Path loss from a point to point prediction model in different conditions, merits of Lee model.

**CELL SITE AND MOBILE ANTENNAS:** Space diversity antennas, Umbrella pattern antennas, and minimum separation of cell site antennas, mobile antennas.

### UNIT-IV

**FREQUENCY MANAGEMENT AND CHANNEL ASSIGNMENT:** Numbering and grouping, Setup access and paging channels, Channel assignments to cell sites and mobile units, Channel sharing and barrowing, Sectorization, Overlaid cells, Non fixed channel assignment.

#### **UNIT-V**

**HANDOFFS AND DROPPED CALLS:** Handoffs initiation, Types of handoff, Delaying handoff, Advantages of handoff, Power difference handoff, Forced handoff, Mobile assisted and soft handoff. Intersystem handoff, Introduction to dropped call rates and their evaluation.

#### **TEXT BOOKS:**

1. Mobile Cellular Telecommunications-W.C.Y.Lee, Mc Graw Hill, 2nd Edn, 1989. **(T1)**
2. Wireless Communications-Theodore. S.Rapport, Pearson Education, 2nd Edn, 2002. **(T2)**
3. Mobile Cellular Communications-Gottapu Sashibhushana Rao, Pearson, 2012. **(T3)**

#### **REFERENCE BOOKS:**

1. Principles of Mobile Communications –Gordon L.Stuber, Springer International, 2<sup>nd</sup> Edn, 2001. **(R1)**
2. Modern Wireless Communications-Simon Haykin, Michael Moher, Pearson Education, 2005. **(R2)**
3. Wireless Communications Theory and Techniques, Asrar U.H.Sheikh, Springer, 2004. **(R3)**
4. Wireless Communications and Networking, Vijay Garg, Elsevier Publications, 2007. **(R4)**
5. Wireless Communications-Andrea Goldsmith, Cambridge University Press, 2005. **(R5)**
6. Cellular and Mobile Communications-V.Jeyasri Arokiamary, Technical Publications **(R6)**

### **X. COURSE PLAN:**

**At the end of the course, the students are able to achieve the following course learning outcomes:**

Lecture No.	CLO	Unit	Course Learning Outcomes	Topics to be covered	Reference
1	1	<b>I</b>	Describe the basic idea and importance of cellular mobile systems.	Introduction to cellular mobile radio systems	R6 1.1
2-3	2		List out the drawbacks of conventional mobile telephone system and explain the basic Cellular Mobile System	Limitations of conventional mobile telephone systems, Basic Cellular Mobile System	T1.1
4	3		Compare various generations of cellular wireless systems	First, second, third, and fourth generation cellular wireless systems	R6 1.10
5	4		Define Fading	Parameters of mobile multipath fading- Time dispersion parameters,	T2 5.4
6				Coherence bandwidth, Doppler spread and coherence time	T2 5.4
7-8	5		Identify different types of small scale fading effects	Types of small scale fading.	T2 5.5
9	6		Formulate the co-channel interference reduction factor	Concept of frequency reuse	R6 2.2
10-12				Co-channel interference, co-channel interference reduction factor	R6 2.3
13-15	7		Evaluate the C/I from Omni-directional antenna systems	Desired C/I from a normal case in a Omni-directional antenna system	R6 2.4
16				system capacity, trunking and grade of service	T2 3.6

17	8		Analyze how to improve the coverage area in cellular systems	Improving coverage and capacity in cellular systems- Cell splitting, Sectoring, Microcell zone concept.	T2 3.7
18-19	9	II	Describe measurement of real time Co-channel interference	Measurement of real time Co-channel interference	R6 3.1
20	10		Design of antenna system	Design of antenna system	R6 3.6
21-22	11		Analyze antenna parameters and their effects	Antenna parameters and their effects	R6 3.7
23-26	12		Differentiate various diversity techniques	Diversity techniques- Space diversity, Polarization diversity, Frequency diversity, Time diversity.	R6 3.8
27-29	13		Explain adjacent channel interference & Discuss near end far end interference, cross talk	Adjacent channel interference, near end far end interference, cross talk	R6 3.9.3
30-32	14		Identify the effects on coverage and interference by power decrease & antenna height decrease	Effects on coverage and interference by power decrease and antenna height decrease	R6 3.9.6
33-34	15		Identify effects of cell site components	Effects of cell site components.	R6 3.9.9
35-36	16	III	Analyze Signal reflections in flat and hilly terrain	Signal reflections in flat and hilly terrain	R6 4.1
37-38	17		Identify effect of human made structures, Phase difference between direct and reflected path	Effect of human made structures, Phase difference between direct and reflected path	R6 4.2-3
39-40	18		Explain constant standard deviation, Straight line path loss slope	constant standard deviation, Straight line path loss slope	R6 4.4
41-42	19		Formulate & Relate mobile propagation over water and flat open area	General formula for mobile propagation over water and flat open area	R6 4.6
43	20		Differentiate near and long distance propagation	Near and long distance propagation	R6 4.7
44-45	21		To Employ Path loss from a point to point prediction model in different conditions merits of Lee model.	Path loss from a point to point prediction model in different conditions merits of Lee model.	R6 4.8
46-48	24		Explain Space diversity antennas, Umbrella pattern antennas & Define minimum separation of cell site antennas, mobile antennas.	Space diversity antennas, Umbrella pattern antennas, minimum separation of cell site antennas, and mobile antennas.	R6 5.4
49-50	25	IV	Define numbering and grouping, Setup access and paging channels	Numbering and grouping, Setup access and paging channels	R6 6.1
51	26		Explain channel assignments to cell sites and mobile units	Channel assignments to cell sites and mobile units	R6 6.3
52	27		Explain channel sharing and barrowing, Sectorization Describe overlaid cells, Non fixed channel assignment.	Channel sharing and barrowing, Sectorization , Overlaid cells, and non fixed channel assignment	R6 6.4
53	28		Discuss the types of handoffs, Delaying handoff	Handoffs initiation, Types of handoff, Delaying handoff	R6 7.1

54-55	29	V	List the advantages of handoff, and Discuss Power difference handoff. Forced handoff, Mobile assisted and soft handoff, Intersystem handoff	Advantages of handoff, Power difference handoff, Forced handoff, Mobile assisted and soft handoff, Intersystem handoff	R6 7.3
56	30		Explain dropped call rates and their evaluation.	Introduction to dropped call rates and their evaluation.	R6 7.7

**XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I		H			S					S			H	S	S
II	H			H	S					S			H	S	
III		H								S			H		
IV	H			H										S	S
V	H			H	S					S				S	

S – Supportive

H - Highly Related

**XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	H	H	S							S			H		
2				H	S					S				S	
3			S								H	S	S		
4	H				S					S				S	
5		H	S								S				
6	H			H	S					S			S		
7			S								H	S		S	S
8	H			H	S					S					
9		H	S										H		
10				S	S										
11	H		S							S					S
12				H	S								S	S	
13	S		S							S					S
14	H			H	S								H		
15	H		S							S				S	S

S – Supportive

H - Highly Related

**Prepared By:**

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