**E.G.S. PILLAY ENGINEERING COLLEGE – NAGAPATTINAM**

**DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING**

**COURSE PLAN**

**COURSE CODE** : EC6801

**COURSE TITLE** : WIRELESS COMMUNICATION

**SEMESTER/DEPT**  : VIII/ECE

**COURSE TIME** : JANUARY 2017 – APRIL 2017

**FACULTY DETAILS**

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| **S.NO** | **NAME OF THE FACULTY** | **OFFICE** | **MAIL ID** |
| 1. | M. Nuthal Srinviasan | ECE DEPARTMENT | nuthal@egspec.org |

**REQUIRED TEXT BOOKS:**

1. Rappaport,T.S., “Wireless communications”, Second Edition, Pearson Education, 2010.

2. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2006.

 **WEB RESOUCES:**

www.freebookcentre.net

www.cse.iitd.ernet.in

www.circuit-magic.com

www.books.google

**PREREQUISITE:** EC6501 : Digital Communication

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| **EC6801 – WIRELESS COMMUNICATION** |
| Course designed by | Anna University, Chennai. |
| Student outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
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| Category | Science | Core | elective |
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| Course coordinator | M. Nuthal Srinivasan |

**OUTCOMES:** Students who have successfully completed this course

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| **Instructional Objective** | **Course Outcome** |
| 1. Identify the characteristics of wireless channel.
2. Learn the various cellular architecture.
3. Realize the concepts behind various digital signaling schemes for fading channels.
4. Recognize the various Multiple antenna and multipath mitigation technique’s.
 | **At the end of the course, students will be able to**1. Illustrate wireless channels
2. Explain the various signaling schemes for fading channels.
3. Design a cellular system.
4. Compare multipath mitigation techniques and analyses their performance.
5. Plan the systems with transmit/receive diversity and MIMO Systems and analyze their performance.
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**ASSESSMENT DETAILS:**

 Unit Test : Written test for 50 Marks in 100 minutes duration

 [5 Short answers x 2marks = 10 marks & 4 Big answer x 10 marks = 10 marks]

Cycle Test – I : Written test for 100 Marks in 3hrs duration

[10 Short answers x 2marks = 20 marks & 5 Big answer x 13 marks =65 marks, One Big answer x 15 = 15]

 Cycle Test – II : Written test for 100 Marks in 3hrs duration

[10 Short answers x 2marks = 20 marks & 5 Big answer x 13 marks =65 marks, One Big answer x 15 = 15]

 Model Exam : Written test for 100 Marks in 3hrs duration

[10 Short answers x 2marks = 20 marks & 5 Big answer x 13 marks =65 marks, One Big answer x 15 = 15]

 Assignment : 2 Numbers of regular syllabus based assignments

 [Tabulation Method, Code Converter, Synchronous and Asynchronous Counter]

 1 Numbers of Innovative assignment.

**DETAILED SESSION PLAN:**

**UNIT I WIRELESS CHANNELS:** Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters-Coherence bandwidth – Doppler spread & Coherence time, Fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

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| **Session No.** | **Topics to be covered** | **Text book** | **Chapter No. and****Page No** | **Content Delivery** | **Testing method** | **Instructional Objective** | **Course Outcome** |
| **Method** | **Level** |
| 1 | Large scale path loss | Rappaport.T,S, Wireless Communication’,Second Edition, Pearson Education, 2010 | Chapter 4 & 105 | LCD Projector | Know ledge | Unit Test | **1** | **A** |
| 2 | Path loss models: Free Space and Two-Ray models | Chapter 4 & 107 | LCD Projector | Under Standing | Unit Test & Model Exam |
| 3 | Link Budget design | Chapter 4 & 138 | LCD Projector | Under Standing | Unit Test |
| 4 | Small scale fading: Parameters of mobile multipath channels | Chapter 5 & 177 | LCD Projector | Applying | Unit Test |
| 5 | Time dispersion parameters: Coherence bandwidth, Doppler spread & Coherence time | Chapter 5 & 197 | LCD Projector | Applying | Unit Test |
| 6 | Fading due to Multipath time delay spread – flat fading | Chapter 5 & 205 | LCD Projector | Applying | Unit Test |
| 7 | Fading due to Multipath time delay spread– frequency selective fading | Chapter 5 & 207 | LCD Projector | Applying | Unit Test & Model Exam |
| 8,9 | Fading due to Doppler spread – fast fading – slow fading. | Chapter 5 & 208 | LCD Projector | Applying | Unit Test & Assignment |

**UNIT II CELLULAR ARCHITECTURE:** Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellular concept- Frequency reuse - channel assignment- hand off- interference & system capacity- trunking & grade of service – Coverage and capacity improvement.

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| **Session No.** | **Topics to be covered** | **Text book** | **Chapter No. and****Page No** | **Content Delivery** | **Testing method** | **Instructional Objective** | **Course Outcome** |
| **Method** | **Level** |
| 1 | Multiple Access techniques - FDMA, TDMA, CDMA | Rappaport.T,S, Wireless Communication’,Second Edition, Pearson Education, 2010 | Chapter – 9Page 449 | LCD Projector | Under standing | Cycle test I & Model Exam | **2** | **C** |
| 2 | Capacity calculations | Chapter – 9Page 471 | LCD Projector | Understanding | Cycle test I |
| 3 | Cellular concept | Chapter – 3Page 57 | LCD Projector | Applying | Cycle test I |
| 4 | Frequency reuse | Chapter – 3Page 58 | LCD Projector | Applying | Cycle test I |
| 5 | channel assignment | Chapter – 3Page 62 | LCD Projector | Applying | Cycle test I & Model Exam |
| 6 | Hand Off | Chapter – 3Page 63 | LCD Projector | Analyze | Cycle test I & Assignment |
| 7 | Interference & System Capacity | Chapter – 3Page 67 | LCD Projector | Analyze | Cycle Test I |
| 8 | Trunking & Grade Of Service | Chapter – 3Page 77 | LCD Projector | Understanding | Cycle test I |
| 9 | Coverage and capacity improvement. | Chapter – 3Page 86 | LCD Projector | Understanding | Cycle test I |

**UNIT III DIGITAL SIGNALING FOR FADING CHANNELS:** Structure of a wireless communication link, Principles of Offset-QPSK, p/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing, PAPR.

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| **Session No.** | **Topics to be covered** | **Text book** | **Chapter No. and****Page No** | **Content Delivery** | **Testing method** | **Instructional Objective** | **Course Outcome** |
| **Method** | **Level** |
| 1 | Structure of a wireless communication link, Principles of Offset | Rappaport.T,S, Wireless Communication’,Second Edition, Pearson Education, 2010 | Chapter – 6Page 294 | LCD Projector | Understanding | Cycle Test I | **3** | **B** |
| 2 | QPSK | Chapter – 6Page 300 | LCD Projector | Understanding | Cycle Test I & Model Exam |
| 3 | p/4-DQPSK | Chapter – 6Page 305 | LCD Projector | Understanding | Cycle Test I |
| 4 | Minimum Shift Keying | Chapter – 6Page 314 | LCD Projector | Analyzing | Cycle Test I |
| 5 | Gaussian Minimum Shift Keying | Chapter – 6Page 318 | LCD Projector | Analyzing | Model Exam |
| 6 | Error performance in fading channels | Chapter – 6Page 319 | LCD Projector | Understanding | Cycle test I |
| 7 | OFDM principle | Chapter – 6Page 328 | LCD Projector | Understanding | Cycle test I |
| 8 | Windowing | Chapter – 6Page 329 | Chalk & Talk | Analyzing | Model Exam |
| 9 | PAPR. | Chapter – 6Page 330 | Chalk & Talk | Analyzing | Assign- ment |

**UNIT IV MULTIPATH MITIGATION TECHNIQUES:** Equalization – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver

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| **Session No.** | **Topics to be covered** | **Text book** | **Chapter No. and****Page No** | **Content Delivery** | **Testing method** | **Instructional Objective** | **Course Outcome** |
| **Method** | **Level** |
| 1 | Equalization – Introduction | Rappaport.T,S, Wireless Communication’,Second Edition, Pearson Education, 2010 | Chapter – 7Page 355 | PPT | Understanding | Cycle test II | **4** | **D** |
| 2 | Adaptive equalization | Chapter – 7Page 359 | PPT | Understanding | Cycle test II |
| 3 | Linear and Non-Linear equalization, | Chapter – 7Page 366 | PPT | Understanding | Model Exam |
| 4 | Zero forcing and LMS Algorithms | Chapter – 7Page 370 | PPT | Understanding | Cycle test II |
| 5 | Diversity - Introduction | Chapter – 7Page 380 | PPT | Analyzing | Cycle test II |
| 6 | Micro and Macro diversity | Chapter – 7Page 381 | PPT | Analyzing | Cycle test II & Model Exam |
| 7 | Diversity combining techniques | Chapter – 7Page 384 | PPT | Understanding | Cycle test II |
| 8 | Error probability in fading channels with diversity reception | Chapter – 7Page 387 | PPT | Understanding | Cycle test II |
| 9 | Rake receiver | Chapter – 7Page 391 | PPT | Understanding | Cycle test II & Assignment |

**UNIT V MULTIPLE ANTENNA TECHNIQUES:** MIMO systems – spatial multiplexing -System model -Pre-coding - Beam forming - transmitter diversity, receiver diversity- Channel state information-capacity in fading and non-fading channels.

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| **Session No.** | **Topics to be covered** | **Text book** | **Chapter No. and****Page No** | **Content Delivery** | **Testing method** | **Instructional Objective** | **Course Outcome** |
| **Method** | **Level** |
| 1 | MIMO systems | Rappaport.T,S, Wireless Communication’,Second Edition, Pearson Education, 2010 | Chapter – 5Page 1 | LCD Projector | Understanding | Cycle test II | **4** | **B,E** |
| 2 | spatial multiplexing | Chapter – 5Page 4 | LCD Projector  | Understanding | Cycle test II & Model Exam |
| 3 | System model | Chapter – 5Page 8 | LCD Projector | Understanding | Cycle test II |
| 4 | Pre-coding | Chapter – 5Page 9 | LCD Projector | Understanding | Cycle test II |
| 5 | Beam forming | Chapter – 5Page 11 | LCD Projector | Understanding | Cycle test II & Assignment |
| 6 | Transmitter diversity | Chapter – 5Page 12 | Chalk & Talk | Applying | Cycle test II |
| 7 | Receiver diversity | Chapter – 5Page 15 | Chalk & Talk | Applying | Cycle test II |
| 8 | Channel state information | Chapter – 5Page 22 | LCD Projector | Understanding | Cycle test II |
| 9 | capacity in fading and non-fading channels | Chapter – 5Page 22 | LCD Projector | Understanding | Model Exam |

**OUTCOME MAPPING**

**PROGRAM EDUCATION OBJECTIVES:**

* Graduate apply their knowledge of mathematics and science to identify, Analyze and solve problems in the field of electronics and develop communication systems
* Graduate exhibit their innovative ideas and management skills to meet the day to day technical challenges.
* Graduate possess a desire for lifelong learning through technical training and professional activities

**PROGRAM OUTCOME:**

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: 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.
5. Modern tool usage: 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.
6. The engineer and society: 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.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with t h e 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.
11. Project management and finance: 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.
12. Life-long learning: 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.

**PSO – Program Specific Outcome:**

1. Develop applications of emerging areas in the field of communication/networking and signal processing.
2. Demonstrate skills in the learning from strongly physical courses viz; semiconductor Technology, embedded systems to existing specific applications.
3. Design and analyze subsystems and /or modules as a team for a variety of comparisons and recent applications in Electronics and Communications.
4. Adapt recent developments in the electronics and communication engineering areas along with state of the art Software tools and effectively project the work in oral and written form with a road map.

**Mapping of CO with PO:**

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| **S.No** | **Course Outcome** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| 1 | Illustrate wireless channels | 3 | 2 | 1 |  |  |  |  |  |  |  |  |  |
| 2 | Explain the various signaling schemes for fading channels. |  |  |  |  |  |  |  |  |  |  |  |  |
| 3 | Design a cellular system. |  |  |  |  |  |  |  |  |  |  |  |  |
| 4 | Compare multipath mitigation techniques and analyses their performance. |  |  |  |  |  |  |  |  |  |  |  |  |
| 5 | Plan the systems with transmit/receive diversity and MIMO Systems and analyze their performance.  |  |  |  |  |  |  |  |  |  |  |  |  |

**Mapping of CO with PSO:**

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|  **S.No** | **Course Outcome** | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** |
| 1 | Illustrate wireless channels | 2 | 2 | 1 | 1 |
| 2 | Explain the various signaling schemes for fading channels. | 3 | 3 | 2 | 1 |
| 3 | Design a cellular system. | 2 | 2 | 3 | 1 |
| 4 | Compare multipath mitigation techniques and analyses their performance. | 2 | 2 | 3 | 1 |
| 5 | Plan the systems with transmit/receive diversity and MIMO Systems and analyze their performance.  | 3 | 3 | 2 | 1 |

Prepared By: M. Nuthal Srinivasan

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