# Detailed Syllabii

## Lecture-wise Breakup

| Subject Code | 17M11EC119 | Semester Odd | Semester Odd Session 2018 - 19<br>Month from July to December |
|---|---|---|---|
| Subject Name | Advanced Wireless and Mobile Communications | | |
| Credits | 03 | Contact Hours | 03 |

| Faculty (Names) | Coordinator(s) | 1. Pankaj Kr. Yadav |
|---|---|---|
| | Teacher(s) (Alphabetically) | 1. Pankaj Kr. Yadav |

| COURSE OUTCOMES | | COGNITIVE LEVELS |
|---|---|---|
| CO1 | To review wireless and mobile communication, Cellular Concept | Remembering (Level I) |
| CO2 | To understand the concept of Propagation of Mobile Radio Signals | Understanding (Level II) |
| CO3 | To analyze the FDMA, TDMA, CDMA, OFDMA techniques wireless and mobile communication | Applying (Level III) |
| CO4 | To evaluate GSM, UMTS and LTE Air Interface | Analyzing (Level IV) |

| Module No. | Subtitle of the Module | Topics in Module | No. of Lectures |
|---|---|---|---|
| 1. | Introduction | Introduction to the wireless communications. Its relevance. Overview. Coverage- syllabi. Recommended reading. Evaluation Scheme. | 4 |
| 2. | Cellular Concept and Engineering | Problems in mobile communication. Need for Cells. Spectrum and its utilization – frequency reuse. Cell design considerations. Cell Topology. Co-channel and adjacent – channel cells interference. Cell splitting and sectoring. Coverage and capacity of cellular system. Hand-off techniques. | 8 |
| 3. | Propagation of Mobile Radio Signals | Radio wave propagation mechanism. Path loss .Outdoor and Indoor propagation models. Antenna types, size and height. Multipath propagation model .Different types of fading. Doppler effect and mobility. | 6 |
| 4. | Multiple Access Techniques | FDMA, TDMA, CDMA, OFDMA techniques and their performance. Number of channels. | 2 |
| 5. | OFDM in LTE | Introduction of Orthogonal Frequency Division Multiplexing, OFDM in LTE | 4 |
| 6. | LTE Radio Access Networks | LTE RADIO INTERFACE; Logical, Transport and physical Channels; Reference Signals, Physical Cell ID, Time-Domain Structure, Scheduling in LTE | 12 |

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|---|---|---|---|
| **7.** | LTE Advancecd and 5G RAN | Introduction of LTE-Advanced and 5G RAN; and Recent developments. | 4 |
| | | **Total number of Lectures** | 40 |


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|---|---|
| **Recommended Reading material:** Author(s), Title, Edition, Publisher, Year of Publication etc. ( Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format) | |
| 1. | T. S. Rappaport, Wireless Communications, PHI, 2002. |
| 2. | Gunnar Heine, GSM Networks: Protocols, Terminology and Implementation, Artech House, 1999. |
| 3. | Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005 |
| 4. | Harri Holma, Antti Toskala, LTE for UMTS: Evolution to LTE-Advanced, John Wiley and Sons, 2011 |
| 5. | 5G Technology Evolution Recommendations, 4G Americas, 2015 |
| 6 | http://www.3gpp.org/ftp/Specs/html-info/36-series.htm |

# Detailed Syllabus
## Lecture-wise Breakup

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|---|---|---|---|
| **Course Code** | 17M12EC125 | **Semester** : Odd 2018 **(specify Odd/Even)** | **Semester** IInd **Session** 2018 -2019 **Month from July – Dec. 2018** |
| **Course Name** | Detection and Estimation Theory | | |
| **Credits** | 3 | **Contact Hours** | 3 |

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| **Faculty (Names)** | **Coordinator(s)** | Dr. Vikram Karwal |
| | **Teacher(s) (Alphabetically)** | Dr. Vikram Karwal |

| **COURSE OUTCOMES** | | **COGNITIVE LEVELS** |
|---|---|---|
| **CO1** | The course aims to familiarize student with stochastic processes and its properties. | Apply Level (C3) |
| **CO2** | The course helps students to analyze probabilistic models and estimate the parameters of the model parameters. | Analyze Level (C4) |
| **CO3** | The course helps students evaluate the observations of the noise-corrupted functions and determine the best estimate of the state. | Evaluate Level(C5) |
| **CO4** | The course helps student compute the optimality criteria to quantify best estimates or detection decisions and limits on performance. | Create Level(C6) |

| **Module No.** | **Title of the Module** | **Topics in the Module** | **No. of Lectures for the module** |
|---|---|---|---|
| **1.** | Review of random variables | Distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of random variables, Schwarz Inequality, Orthogonality principle in estimation, Central limit theorem, Random Process, stationary process, autocorrelation and autocovariance functions, Spectral representation of random signals, Wiener Khinchin theorem, Properties of power spectral density, Gaussian Process and white noise | 5 |
| **2.** | Parameter estimation theory | Principal of estimation and applications, Properties of estimates, unbiased and consistent estimators, MVUE, CR bound, Efficient estimators; Criteria of estimation: the methods of maximum likelihood and its properties; Baysean estimation: Mean Square error and MMSE, Mean Absolute error, Hit and Miss cost function and MAP estimation | 7 |
| **3.** | Estimation of signal in presence of White Gaussian Noise(WGN) | Linear Minimum Mean-Square Error(LMMSE) Filtering: Wiener Hoff Equation FIR Wiener filter, Causal IIR Wiener filter, Noncausal IIR Wiener filter, Linear prediction of signals, Forward and Backward Predictions, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters | 8 |
| **4.** | Complexity Computations | Principle and Application, Steepest Descent Algorithm, Convergence characteristics; LMS algorithm, convergence, excess mean square error, Leaky LMS algorithm; Applications of Adaptive filters; RLS algorithm, derivation, | 8 |

| | | | |
|---|---|---|---|
| | | Matrix inversion Lemma, Initilization, tracking of nonstationarity. | |
| **5.** | Kalman Filtering | Principle and application, Scalar Kalman filter, Vector Kalman filter | 3 |
| **6.** | Detection Theory | Hypothesis testing, Bayesian, Neyman-Pearson and Minimax detetion, Composite Hypothesis testing, Generalized LRT, Sequential and Distributed Detection, Non-parametric detection, Detection in Gaussian noise | 9 |
| | | **Total number of Lectures** | **40** |

**Evaluation Criteria**

| **Components** | **Maximum Marks** |
|---|---|
| T1 | 20 |
| T2 | 20 |
| End Semester Examination | 35 |
| TA | 25 (5 Assignment, 5 Quiz, 5 Class Participation, 10 Attendance) |
| **Total** | **100** |

**Recommended Reading material:** Author(s), Title, Edition, Publisher, Year of Publication etc. ( Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)


| | |
|---|---|
| **1.** | An Introduction to Signal Detection and Estimation by H. Vincent Poor |
| **2.** | Linear Estimation by Thomas Kailath, Ali H sayed, Babak Hassibi |
| **3.** | Fundamentals of Statistical Signal Processing: Detection theory by Steven M Kay |
| **4.** | Fundamentals of Statistical Signal Processing: Estimation theory by Steven M Kay |

# Detailed Syllabus

## Lecture-wise Breakup

| **Subject Code** | 18M12EC114/17M22EC113 | **Semester** Odd | **Semester** FIRST **Session** 2018-19<br>**Month from** July to Dec |
|---|---|---|---|
| **Subject Name** | HDL Based Digital Design | | |
| **Credits** | 3 | **Contact Hours** | 3 |

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| **Faculty (Names)** | **Coordinator(s)** | Atul Kumar Srivastava |
| | **Teacher(s) (Alphabetically)** | Atul Kumar Srivastava , Shruti Kalra |

**Course Objectives:**

- Verilog IEEE 1364 standard
- Hardware Descriptive language programming (RTL, testbenches & UDP's)
- Combinational & Sequential Circuit Description
- Component Test & Verification

**Course Outcome:**

- Logic Design with Verilog, Gate level and data flow modeling, FSM modeling, Fault analysis , synthesis and FPGA's

| **COURSE OUTCOMES** | | **COGNITIVE LEVELS** |
|---|---|---|
| **CO1** | Understand the concept of Verilog and their application in Digital systems design systems. | Understanding (C1) |
| **CO2** | Identify theoretical and practical requirements for implementation and designing of Finite state machines. | Applying (C3) |
| **CO3** | Understand the concept of Asynchronous Finite State Machines and their application in Digital systems design systems. | Understanding (C1) |
| **CO4** | Understand the concept of Fault and Analysis in Digital systems design systems | Analyzing (C4) |

| **Module No.** | **Subtitle of the Module** | **Topics in the module** | **No. of Lectures for the module** |
|---|---|---|---|
| 1. | HDL Based Design | Introduction to Logic Design with Verilog, Gate Level, data flow level, UDP, data types, behavioral level, ,structural modeling, operators, test bench, function and task, system task, compiler directive, synchronization, FSM Modeling | **17** |
| 2. | Finite State Machine (FSM) | FSM Design methodology, Pulse generations, Frequency Dividers, conversion between Mealy and Moore, State Reduction, State Assignment, Implementation, and state diagram | **8** |

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|---|---|---|---|
| | | partitioning | |
| 3. | Asynchronous Finite State Machines | Asynchronous Analysis, Design of Asynchronous Machines, Flow table realization, reduction, state assignments and design, Cycle and race analysis. Hazards, Essential Hazards, and its removal | **9** |
| 4. | Fault Analysis | s-a-0, s-a-1 fault analysis using path sensitization method, Boolean Difference Method, | **5** |
| 5. | Introduction to FPGA | FPGA Architecture, Implementation using ISE, System Generator based Implementation, Accel DSP based implementation | 4 |
| | | | |
| | | **Total number of Lectures** | **43** |

**Recommended Reading material:** Author(s), Title, Edition, Publisher, Year of Publication etc. ( Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)


| | |
|---|---|
| 1. | Roth, Charles H. *Digital systems design using VHDL*. Vol. 20. PWS publishing company, 1998. |
| 2. | Bhasker, Jayaram, and Jayaram Bhasker. *A Vhdl primer*. Prentice Hall PTR, 1999. |
| 3. | Pedroni, Volnei A. Circuit design with VHDL. MIT press, 2004. |
| 4. | Z.Kohavi: Switching and Finite Automata Theory, 2nd Edition, Tata Mc-Graw Hill, 2001 |
| 5. | A. Anand Kumar : Fundamental of Digital Circuits, PHI, 2nd Edition 2012 |

<u>**Detailed Syllabus**</u>
**Lecture-wise Breakup**

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|---|---|---|---|
| **Course Code** | 18M12EC115 | **Semester** ODD **(specify Odd/Even)** | **Semester** ODD **Session** 2018 - 2019 **Month from** July - December |
| **Course Name** | Advanced Optical Communication Systems | | |
| **Credits** | 3 | **Contact Hours** | 3 |

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|---|---|---|
| **Faculty (Names)** | **Coordinator(s)** | Dr Amit Kumar Goyal |
| | **Teacher(s) (Alphabetically)** | Dr Amit Kumar Goyal |

| **COURSE OUTCOMES** | | **COGNITIVE LEVELS** |
|---|---|---|
| **CO1** | Develop an understanding of optical fiber, its structure, types, propagation, transmission and non-linear properties. | Remembering (Level I) |
| **CO2** | Identify and examine the different kinds of losses and signal distortion along with their compensation techniques in optical Fibers. | Analyzing (Level IV) |
| **CO3** | Classify the Optical sources and detectors and their principle of operation. Analize various coupling techniques. | Understanding (Level II) |
| **CO4** | Design a fiber optic link based on budget analysis. | Evaluating (Level V) |

| **Module No.** | **Title of the Module** | **Topics in the Module** | **No. of Lectures for the module** |
|---|---|---|---|
| **1.** | Overview of Optical fiber Communications | Introduction to fiber optics, Physics of light. Principles of fiber optics: Introduction, light propagation, Skew rays. TIR condition, FTIR, Goos-hanchen shift.<br>Effective index method to determine propagation constant, Fibers Modes, V Number analysis for optical fiber, Significance of V-b diagram, Mode Coupling, Step Index fibers, Graded Index fibers.<br>Single mode fibers- Cut off wavelength, line width, propagation velocities. Non-linear effects in optical fiber | 7 |
| **2.** | Signal Degradation in Optical fibers | Signal distortion in optical fibers- Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses. Information capacity, Group delay, Types of Dispersion - Material dispersion, Wave-guide dispersion, Intermodal dispersion, Fiber Birefringence, Polarization Mode Dispersion.<br>Introduction to Dispersion compensation techniques, Advanced chromatic dispersion compensation, Advanced PMD compensation (both optical and electrical). | 7 |

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| **3.** | Optical Sources | Light emitting diode (LEDs)- structures designing and performance analysis, Quantum efficiency, Power, Modulation, Laser Diodes -Modes & threshold conditions, resonant frequencies, structures, characteristics single mode lasers, Modulation of laser diodes, external quantum efficiency, laser diode rate equations. Source to fiber power launching: - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Various fiber to light coupling techniques, Laser diode to fiber coupling, LED coupling to single mode fiber. | 8 |
| **4.** | Photodetectors & Receivers | Optical detectors- principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Optical receiver: Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of error, Quantum limit, Analog receivers. | 8 |
| **5.** | Optical system design | Optical Amplification, Doped fiber amplifier, semiconductor optical amplifier, Analog and digital systems. Coherent optical fiber communication systems. Modulation and line coding. Bandwidth and rise time budgets, Power budget, and dynamic range. Power penalty, Channel capacity measurement. | 6 |
| **6.** | Advanced Optical Systems and Networks | Wavelength Division Multiplexing. Long haul and metro WDM system, WDM system analysis, design and performance evaluation, Introduction to Photonic crystal technology, Photonic crystal fibers, Introduction to Optical Networks, Local area network, Metropolitan-Area N/W,SONET/SDH, Introduction to Free Space optical Communication. | 8 |
| **7.** | | | |
| | | **Total number of Lectures** | **44** |

**Evaluation Criteria**

| **Components** | **Maximum Marks** |
|---|---|
| T1 | 20 |
| T2 | 20 |
| End Semester Examination | 35 |
| TA | 25 |
| **Total** | **100** |

**Recommended Reading material:** Author(s), Title, Edition, Publisher, Year of Publication etc. ( Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)


| | |
|---|---|
| **1.** | Gerd Keiser, Optical Fiber Communications, 3rd Edition, McGraw-Hill International edition, 2000. |
| **2.** | John M. Senior, Optical Fiber Communications, 2nd Edition, PHI, 2002. |
| **3.** | D.K. Mynbaev, S.C. Gupta and Lowell L. Scheiner, Fiber Optic Communications, Pearson Education, 2005. |
| **4.** | Govind P. Agarwal, Fiber Optic Communication Systems, 3rd Edition, John Wiley, 2004. |

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|---|---|
| **5.** | Joseph C. Palais, Fiber Optic Communications, 4th Edition, Pearson Education, 2004 |
| **6.** | Journal articles i.e. IEEE, Springer, IOPscience, Elsevier and Video lectures from nanohub, NPTEL, MIT video lectures |

## Detailed Syllabus
## Lab-wise Breakup

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|---|---|---|---|
| **Course Code** | 17M17EC330 | **Semester ODD (specify Odd/Even)** | **Semester** 3rd **Session** 2018 -2019 **Month from** July to Dec |
| **Course Name** | Project Based Learning-3 | | |
| **Credits** | 4 | **Contact Hours** | **8** |

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|---|---|---|
| **Faculty (Names)** | **Coordinator(s)** | Dr. Madhu Jain |
| | **Teacher(s) (Alphabetically)** | Dr. Gaurav Verma, Dr. Neetu Singh Ms. Ruby Beniwal, Ms. Smriti Bhatnagar |

| **COURSE OUTCOMES** | | **COGNITIVE LEVELS** |
|---|---|---|
| **CO1** | Summarize the contemporary scholarly literature, activities, and explored tools/ techniques/software/hardware for hands-on in the respective project area in various domain of Embedded Systems, Signal Processing, VLSI, Communication, Artificial Intelligence and Machine Learning/Deep Learning etc. | Understanding (Level II) |
| **CO2** | Analyze/ Design the skill for obtaining the optimum solution to the formulated problem with in stipulated time | Analyzing (Level IV) |
| **CO3** | Use latest techniques and software tools for achieving the defined objectives. Evaluate /Validate sound conclusions based on evidence and analysis | Evaluating (Level V) |
| **CO4** | Demonstrate the oral and written communication skills. Describe the importance of possible future developments in the selected domain | Creating (Level VI) |

**Evaluation Criteria**

| | | | |
|---|---|---|---|
| (i) | Each fortnightly assessment | | -8% |
| | (First assessment should be at the end of 3rd week from the beginning of the semester and thereafter fortnightly assessment. A total of six assessments giving a total percentage 6 x 8 = 48%) | - | 48% |
| (ii) | Report at the end of the semester | - | 10% |
| (iii) | Semester end presentation by the students | - | 10% |
| (iv) | Viva-voce at the end of the semester | - | 16% |
| (v) | Peer group evaluation (i.e. evaluation by the fellow students not belonging to the same batch) | - | 8% |
| (vi) | Self assessment by the student concerned (can be moderated by the instructor by discussig with the student concerned) | - | 8% |

**Detailed Syllabus**
**Lecture-wise Breakup**

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|---|---|---|---|
| **Subject Code** | 17M21EC111 | **Semester** Odd | **Semester** I **Session** 2019-20<br>**Month from** July **to** December |
| **Subject Name** | Microelectronic Devices Technology and Design Interface | | |
| **Credits** | 3 | **Contact Hours** | 3 |

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|---|---|---|
| **Faculty (Names)** | **Coordinator(s)** | Dr Saurabh Chaturvedi |
| | **Teacher(s) (Alphabetically)** | Dr Saurabh Chaturvedi |

| **COURSE OUTCOMES -** At the end of the course, students will be able to: | | **COGNITIVE LEVELS** |
|---|---|---|
| **CO1** | -Relate and recall the concepts of semiconductor physics, devices and technology | Remembering (Level I) |
| **CO2** | -Understand the MOS structure and explain the operation of MOS transistors | Understanding (Level II) |
| **CO3** | -Apply the knowledge of MOSFET scaling, short-geometry effects and fabrication techniques in advanced nanoscale devices and circuits | Applying (Level III) |
| **CO4** | -Analyze the device layout and characteristics<br>-Analyze design flow and design interface | Analyzing (Level IV) |

| **Module No.** | **Title of the Module** | **Topics in the Module** | **No. of Lectures** |
|---|---|---|---|
| 1. | Semiconductor physics | Semiconductor materials, Energy bands, Intrinsic carrier concentration, Doping, Carrier drift and diffusion, Generation and recombination processes, Continuity equation, Thermionic emission process, p-n junction | 11 |
| 2. | MOS capacitor | MOS structure, MOS system under external bias | 7 |
| 3. | MOS transistor | Physical structure of MOS transistor, Types, Threshold voltage, MOSFET operation, Layout, MOSFET capacitances, SPICE models | 11 |
| 4. | Scaling of MOS transistor | Types of scaling, Short-geometry effects, Introduction to SPICE model parameters | 4 |
| 5. | Fabrication of MOS transistor | Basic steps, n-well CMOS process, Twin-tub technology | 3 |
| 6. | Overview of CMOS/VLSI technology | CMOS technology, VLSI design methodologies, VLSI design flow, Design hierarchy, VLSI design styles | 3 |
| 7. | Design interface | CMOS lambda-based design rules, Foundry interface | 3 |

| **Total number of lectures** | 42 |
|---|---|
| **Evaluation Criteria**<br>**Components**     **Maximum Marks**<br>T1     20<br>T2     20<br>End Semester Examination     35<br>TA     25<br>**Total**     **100** | |

| **Recommended Reading Material:** | |
|---|---|
| 1. | S. M. Sze, *Semiconductor devices: Physics and technology*, 2nd ed., John Wiley & Sons, 2009. |
| 2. | A. B. Bhattacharyya, *Compact MOSFET models for VLSI design*, 1st ed., Wiley-IEEE Press, 2009. |
| 3. | Y. Tsividis, *Operation and modeling of the MOS transistor*, 2nd ed., Oxford University Press, 2009. |

# Detailed Syllabus

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|---|---|---|---|
| **Course Code** | 17M17EC218 | **Semester** Odd **(specify Odd/Even)** | **Semester** 10th **Session** 2018-2019 **Month from** July to December |
| **Course Name** | Seminar and Term Paper | | |
| **Credits** | 4 | **Contact Hours** | |

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| **Faculty (Names)** | **Coordinator(s)** | Dr Saurabh Chaturvedi |
| | **Teacher(s) (Alphabetically)** | |

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| **COURSE OUTCOMES -** At the end of the course, students will be able to: | | **COGNITIVE LEVELS** |
| **CO1** | Understand relevant theories, methods and research design relating to the seminar topic selected by a student | Understanding (Level II) |
| **CO2** | Analyze the work of other authors/researchers and contribute to the field of knowledge with the cooperation of the supervisor | Analyzing (Level IV) |
| **CO3** | Evaluate the previously published research works, findings and conclusions | Evaluating (Level V) |
| **CO4** | - Develop and refine the master's dissertation topic and proposal<br>- Develop the effective technical writing, communication and presentation skills | Creating (Level VI) |

**Evaluation Criteria**

| **Components** | **Maximum Marks** |
|---|---|
| Day to day work done prior to mid-term | 20 |
| Mid-term seminar/presentation | 20 |
| Day to day work done prior to end-term | 20 |
| End-term seminar/presentation | 20 |
| End-term report - Term Paper | 20 |
| **Total** | **100** |

**Detailed Syllabus**
**Lab-wise Breakup**

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|---|---|---|---|
| **Course Code** | 17M15EC113 | **Semester: Odd 2018** **(specify Odd/Even)** | **Semester** ... **Session** 2018 -2019 **Month from** July to December |
| **Course Name** | ECE Design and Simulation Lab -I | | |
| **Credits** | | **Contact Hours** | |

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|---|---|---|
| **Faculty (Names)** | **Coordinator(s)** | Vikram Karwal |
| | **Teacher(s) (Alphabetically)** | Vikram Karwal, Vivek Dwivedi |

| **COURSE OUTCOMES** | | **COGNITIVE LEVELS** |
|---|---|---|
| **CO1** | At the end of the module the student will be able to explain relative merits and demerits of wireless communication technologies. | Remembering Level I |
| **CO2** | At the end of the lab the students will be able to simulate the radio propagation model | Understanding Level II) |
| **CO3** | Plan a wireless communications system for a given environment in which it is to be deployed. | Applying Level III |
| **CO4** | Select a wireless technology or a combination of technologies to suit a given application. | Analyzing Level IV |
| **CO5** | Use of MIMO technology in 5G communication | Evaluating Level V |
| **CO6** | Perform measurements with commercial equipment and understand the effects of radio channel on the OFDM signal as well as strategies to compensate them | Creating Level VI |

| **Module No.** | **Title of the Module** | **List of Experiments** | **CO** |
|---|---|---|---|
| **1.** | Exp.1 | Introduction to MATLAB and its various applications. | CO1 |
| **2.** | Exp.2 | To study and simulate Rayleigh distribution using two signals that follow normal distribution. | CO2 |
| **3.** | Exp.3 | To study and simulate Rician distribution using two signals that follow normal distribution. | CO2 |
| **4.** | Exp.4 | To study and simulate Propagation Path loss Models: Free Space Propagation, log distance and log normal. | CO2 |
| **5.** | Exp.5 | To write a MATLAB program to calculate the median path loss for Outdoor Propagation – Okumura Model and Hata Model. | CO3 |
| **6.** | Exp.6 | To study atmospheric turbulence models and implement them using MATLAB. | CO3 |
| **7.** | Exp.7 | To study and simulate the SISO outdoor channel models i.e. FWGN channel model and Jakes model. | CO4 |
| **8.** | Exp.8 | To simulate the channel capacity for MIMO system. | CO5 |
| **9.** | Exp.9 | To analyze the performance of MIMO systems by using space time code technique. | CO5 |
| **10.** | Exp.10 | OFDM systems implementation using MATLAB | CO6 |
| **11.** | Exp.11 | To obtain the PAPR analysis of single-carrier signal and the performance of PAPR & BER with clipping and filtering | CO6 |

| | | | |
|---|---|---|---|
| | | reduction technique. | |
| **12.** | Exp.12 | Final Project Based on the pre-knowledge of wireless communication system.- Adaptive Channel Estimation and Data Estimation | |

**Evaluation Criteria**

| **Components** | **Maximum Marks** |
|---|---|
| Viva -1 | 20 |
| Viva -2 | 20 |
| D2D | 60 |
| **Total** | **100** |

| | |
|---|---|
| **Recommended Reading material:** Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format) | |
| **1.** | Principles of Communication Systems Simulation with Wireless Applications William H. Tranter K. Sam Shanmugan Theodore S. Rappaport Kurt L. Kosbar |
| **2.** | Digital Communication over Fading Channels -A Unified Approach to Performance Analysis By Marvin K. Simon Mohamed-Slim Alouini |
| **3.** | Adaptive Filters by Ali H Sayed |