**DAYANANDA SAGAR COLLEGE OF ENGINEERING**

**DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING**

**SCHEME OF TEACHING AND EXAMINATION 2018-2022**

**VII SEMESTER**

**AUTONOMOUS COURSE**

**175 Credits**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Sl.  No | Subject  Code | Subject | Teaching  Dept. | Board | Teaching  Hours / week | | | | Examination | | | | | | Credits |
| **L** | **T** | **P** | | **hrs** | **CIE** | | **SEE** | | **Total** |
| 1 | 18EC7DCWMC | Wireless & Mobile Communications | ECE | ECE | 4 | 0 | 0 | | 4 | 50 | | 50 | | 100 | 4 |
| 2 | 18EC7DEXXX | Department Elective - D | ECE | ECE | 3 | 0 | 0 | | 3 | 50 | | 50 | | 100 | 3 |
| 3 | 18EC7DEXXX | Department Elective - E | ECE | ECE | 3 | 0 | 0 | | 3 | 50 | | 50 | | 100 | 3 |
| 4 | 18EC7IEXXX | Institutional Elective - 2 | ECE | ECE | 3 | 0 | 0 | | 3 | 50 | | 50 | | 100 | 3 |
| 5 | 18EC7ICPR1 | Project Work Phase - I | ECE | ECE | 0 | 0 | 2 | | 2 | 50 | | 50 | | 100 | 2 |
| 6 | 18EC6DLADC | Advanced Communication Lab | ECE | ECE | 0 | 1 | 2 | | 2 | 50 | | 50 | | 100 | 2 |
| 7 |  | Internship |  |  |  |  |  | |  |  | |  | |  |  |
| 10 |  |  |  |  |  | | | | | | | | | |  |
| Total | | | | |  |  |  |  | | 300 | 300 | | 600 | | **17** |

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| **ELECTIVE-D** | | **ELECTIVE-E** | |
| 18EC7DEDIT | Internet of Things & Cloud Computing | 18EC7DEEME | Microwave Engineering |
| 18EC7DEDAI | Artificial Intelligence & Robotics | 18EC7DEEMN | Introduction to MEMS & NEMS |
| 18EC7DEDAD | ASIC Design | 18EC7DEESV | System Verilog for Verification |
| 18EC7DEDFC | Fiber Optic Communications | 18EC7DEECS | Cryptography & Network Security |

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| **INSTITUTIONAL ELECTIVE - 2** | |
| 18EC7IE2GA | GPS and its applications |

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| **Project Work Phase - I** | **Internship** |
| To be taken up during VII semester. The student has to identify the domain of interest, draft the objectives of the project, carry out detailed Literature Survey and define problem statement. The student has to submit the report before the deadline announced by the Department. Phase – I has both CIE and SEE. | All the students admitted to III year of BE have to undergo mandatory internship of 4 weeks during the vacations of VI and VII semesters and /or VII and VIII semesters. Examination will be conducted during VIII semester and prescribed credits are added to VIII semester. Internship is considered as a head of passing and is considered for the award of degree. Those, who do not take-up/complete the internship will be declared as failed and have to complete during subsequent examination after satisfying the internship requirements. |
| **Institution Elective:** Students can select any one of the Institution electives offered by any Department. Candidate will be offered with an Institution elective,   * If the candidate has not studied the same course during the earlier courses of the program. * The syllabus content of Institution elective is not similar to that of Departmental core courses or professional electives. * A similar course, under any category, is not prescribed in the higher semesters of the programme. Registration to electives shall be documented under the guidance of Programme Coordinator/ Adviser/Mentor. | |

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| **WIRELESS AND MOBILE COMMUNICATION** |

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| **Course Code :** 17EC7DCWMC **L : P : T : S :** 4 : 0 : 0 : **0**  **Exam Hours :** 3  **Total Hours :** 50 | **Credits :** 4  **CIE Marks :** 50  **SEE Marks :** 50  **CIE + SEE :** 100 |

**COURSE OBJECTIVES:**

1. To impart knowledge of types of wireless communication and its importance.
2. To make students to recognize the problems in wireless channel for communication and model the channel for analysis.
3. Grasp the techniques used to tackle different aspects of communication in cellular Technology.
4. Identify significance of design trade-offs in mobile technology.

**COURSE OUTCOMES:**

At the end of the course, student will be able to

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| **CO1** | Analyse radiation patterns of antenna and arrays. |
| **CO2** | Analyze various propagation models suitable for mobile radio communication. |
| **CO3** | Discuss cellular radio concepts. |
| **CO4** | Apply design trade-offs in mobile technology to optimize the systems in different aspects. |
| **CO5** | Investigate how the mobile technology handles various scenarios in cellular communication. |
| **CO6** | Summarise different multiple access techniques and technical features of mobile communication systems. |

**Mapping of Course Outcomes to Program Outcomes:**

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|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 1 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 2 | 1 | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 2 | 2 | 1 | - | - | - | - | - | - | - | - |
| **CO4** | 3 | 2 | 2 | 1 | - | - | - | - | - | - | - | - |
| **CO5** | 3 | 3 | 2 | 2 | - | - | - | 1 | 1 | - | - | - |
| **CO6** | 3 | ~~1~~ | - | - | - | - | - | - | - | - | - | - |

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| **Module** | **Course Content** | **Hours** | **CO’s** |
| 1 | **Antenna basics**: Introduction, Basic antenna parameters, patterns, Beam area, Radiation intensity, Beam efficiency, Directivity and Gain, Directivity and resolution, Antenna apertures, Effective height, Radio communication link, fields from oscillating dipole, antenna field zones  **Point sources and Arrays**: Introduction, power patterns, Power theorem, Radiation intensity, Field patterns, Arrays of two isotropic point sources, Non-isotropic but similar point sources |  |  |
| 2 | **Mobile communication channels and channel models:**  **Introduction to radio propagation, radio paths,** Attenuation, Three basic propagation mechanisms, mobile radio channel, Free Space path loss Model, Two ray propagation model-description, Indoor propagation models, long distance propagation | 10 | CO3 |
| 3 | **Cellular concept :** Cellular terminology, cell structure and cluster, Frequency Reuse, cluster size and system capacity, locating channel cells, System parameters to increase cell coverage, coverage hole filters and leaky feeders, system parameters to reduce interference, methods to increase traffic capacity, cell splitting | 10 | CO2 |
| 4 | Multiple access techniques and Generations of mobile  FDMA, TDMA, CDMA, OFDMA, Comparison of Multiple-Acess techniques. History of mobile communication system-1G, 2G, 3G, 4G, 5G | 10 | CO4  CO5 |
| 5 | 4G and LTE :  Architectural review of UMTS and GSM, The need for LTE, From UMTS to LTE, From LTE to LTE advanced, 3GPP specifications for LTE. | 10 | CO6 |

**NOTE:**

1. Questions for CIE and SEE not to be set from self-study component.

2. Assignment Questions should be from self-study component only.

**Self-Study Components:**

UNIT 1 : Antennas for mobile communications

UNIT 2 : Simulation of wireless fading channels ,Outdoor propagation models.

UNIT 3 : Higher end modulations used in mobile communications such as GMSK, OQPSK, 16QAM

UNIT 4 : Simulation of digital modulation techniques: MSK, OQPSK, QAM and BER calculation.

UNIT 5 : Study of 3GPP recommendations

**TEXT BOOKS:**

1. T.L. Singal, “Wireless Communications”, *Tata McGraw hill Education Pvt. Ltd*,2010.
2. John D. Krauss, “Antennas and Wave Propagation”, 4thEdn, *McGraw-Hill International edition*, 2010.
3. Chritopher Cox, “An introduction to LTE: LTE, LTE advanced, Vo LTE and 4G Mobile communications ” Second Edition, Wiley publications

**REFERENCES:**

1. Theodore Rappaport, “Wireless Communications: Principles and Practice”, 2nd Edition. Pearson Education *Inc*, 2002.
2. Lee. W.C.Y., “Mobile Cellular Telecommunications”, *McGraw-Hill*, New York, 19952nd Ed*.*
3. A. Goldsmith, “Wireless Communication”, *Cambridge University Press*, 2005
4. Upena Dalal, “Wireless Communication”, *Oxford University Press*, 2009

**Scheme of Evaluation of the CIE & Assessment Pattern :**

**Assignment :** Only one assignment (open book test normally) will be of 10 marks & conducted in the class during the course of the semester (normally midway thro’ the semester or in between 2nd & 3rd test). Generally, 2- 4 questions can be given which has to be solved in 1 hour duration, the assignment question has to be from the self-study component or it can be a coding demo done in the laptop & shown on the spot to the teacher in the class.

**Quiz :** There will be 1 quiz of 30 questions of 1 marks each, which will be reduced to 10 marks, which may be conducted along with the 2nd CIE test or at the appropriate time during the course of the semester.

**CIE :** There will be 3 CIE tests in a semester conducted for 50 marks with 10 Marks MCQs, remaining 40 Marks descriptive (with theory & problems), each of 10 Marks, each CIE will be reduced to 10 Marks and totalled up for 30 Marks. There will be choices in the descriptive questions.

**CIE – Continuous Internal Evaluation Theory (50 Marks) :**

|  |  |  |  |
| --- | --- | --- | --- |
| **Bloom’s Category** | **Tests - 3 CIEs** | **Assignment - 1 No.** | **Quiz - 1 No.** |
| **Marks (Out of 50)** | **30** | **10** | **10** |
| Remember | 10 | 03 |  |
| Understand | 10 | 03 |  |
| Apply | 5 | 02 |  |
| Analyze | 5 | 02 |  |
| Evaluate |  |  |  |
| Create |  |  |  |

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| **Internet of Things and Cloud Computing** |

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| **Course Code :** 18EC7DEDIT  **L : P : T : S :** 3 : 0 : 0 : **0**  **Exam Hours :** 3  **Total Hours :** 50 | **Credits :** 3  **CIE Marks :** 50  **SEE Marks :** 50  **CIE + SEE :** 100 |

**COURSE OBJECTIVES:**

1. To study the basics framework and architecture of Internet of Things (IoT).
2. To gain knowledge of IoT design principles.
3. To understand the Internet connectivity principles in IoT.
4. Outline cloud computing paradigm for data collection, storage and computing services
5. To gain knowledge of security model, security profiles and security protocols for IoT

**COURSE OUTCOMES:**

At the end of the course, student will be able to

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| --- | --- |
| **CO1** | Understand the framework of IoT and Architecture view. |
| **CO2** | Analyze the implementation of IoT/M2M Design principles. |
| **CO3** | Design of web for enhancement of IoT Technologies. |
| **CO4** | Create the Cloud based platform leading to Everything as a Service(EaaS) |
| **CO5** | Management of Privacy, Security and Treats to Cloud based IoT Systems |
| **CO6** | Provide solutions to complex problems using IoT based Cloud Computing |

**Mapping of Course Outcomes to Program Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | ~~3~~ | 2 | 1 | 1 |  |  |  |  |  |  |  |
| **CO2** | 3 | ~~3~~ | 2 | 1 |  |  |  |  |  |  |  |  |
| **CO3** | 3 | 3 | 2 | 1 |  |  |  |  |  |  |  |  |
| **CO4** | 3 | 3 | ~~1~~ | ~~1~~ |  |  |  |  |  |  |  |  |
| **CO5** | 3 | 3 | ~~1~~ |  |  |  |  |  |  |  |  |  |
| **CO6** | 3 | ~~3~~ | 3 | 3 | 3 |  |  | 1 | 3 |  | 3 | 1 |

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| **Module** | **Course Content** | **Hours** | **CO’s** |
| 1 | **Internet of Things: An Overview-** Internet o thing, IoT Conceptual Framework, IoT Architectural view, Technology behind IoT, Sources of IoT, M2M Communication. | 09 |  |
| 2 | **Design Principles of Connected Devices:** Introduction, IoT/M2Msystems layers and design standardization, Communication Technologies, Data enrichment, data consolidation and device management at gateway | 07 |  |
| 3 | **Design Principles for Web Connectivity:** Introduction, Web Communication Protocols for Connected Devices, Message Communication Protocols for Connected Devices and Web Connectivity for Connected-Devices Network using Gateway, SOAP, REST, HTTP RESTful and WebSockets. | 09 |  |
| 4 | **Data Collection, Storage and Computing Using a Cloud Platform: Introduction, Cloud Computing Paradigm for Data Collection, Storage and Computing, Everything as a Service and Cloud Service Models, IoT Cloud-Based Services using the Xively and NImbits.** | 08 |  |
| 5 | **IoT Privacy, Security and Vulnerabilities Solutions:** Introduction, Vulnerabilities, Security Requirements and Threat Analysis, IoT Security Tomography and Layered Attacker Model, Identity Management, and Establishment, Access Control And Secure Message Communication, Security Models, Profiles and Protocols for IoT, | 07 |  |

**NOTE:**

1. Questions for CIE and SEE not to be set from self-study component.

2. Assignment Questions should be from self-study component only.

**Self-Study Components:**

Module 1: Examples of IoT: Wearable Smart Watch, Smart Home, Smart Cities,

Module 2: Ease of Designing and Affordability

Module 3:

Module 4: Using Public Cloud IoT Platforms

Module 5: Use Cases and Misuse Cases,

**TEXT BOOKS:**

1. **“Internet of Things: Architecture and Design Principles”**, Raj Kamal, 2017 McGraw Hill publications. ISBN=9789352605224, https://books.google.co.in/books?id=KuOizQEACAAJ

**REFERENCES:**

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, **“From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”,** 1st Edition, Academic Press, 2014.(**ISBN-13:** 978-0124076846)
2. Vijay Madisetti and ArshdeepBahga, **“Internet of Things (A Hands-on-Approach)”,** 1stEdition, VPT, 2014.(**ISBN-13:** 978-8173719547)
3. Hassan, Q.F., Atta ur, R.K., & Madani, S.A. (2017). “Internet of Things: Challenges, Advances, and Applications” (1st ed.). CRC Press. <https://doi.org/10.1201/9781315155005>
4. Rajkumar Buyya , James Broberg, Andrzej Goscinski: Cloud Computing Principles and Paradigms, Willey 2014.

**Scheme of Evaluation of the CIE & Assessment Pattern :**

**Assignment :** Only one assignment (open book test normally) will be of 10 marks & conducted in the class during the course of the semester (normally midway thro’ the semester or in between 2nd & 3rd test). Generally, 2- 4 questions can be given which has to be solved in 1 hour duration, the assignment question has to be from the self-study component or it can be a coding demo done in the laptop & shown on the spot to the teacher in the class.

**Quiz :** There will be 1 quiz of 30 questions of 1 marks each, which will be reduced to 10 marks, which may be conducted along with the 2nd CIE test or at the appropriate time during the course of the semester.

**CIE :** There will be 3 CIE tests in a semester conducted for 50 marks with 10 Marks MCQs, remaining 40 Marks descriptive (with theory & problems), each of 10 Marks, each CIE will be reduced to 10 Marks and totalled up for 30 Marks. There will be choices in the descriptive questions.

**CIE – Continuous Internal Evaluation Theory (50 Marks) :**

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| --- | --- | --- | --- |
| **Bloom’s Category** | **Tests - 3 CIEs** | **Assignment - 1 No.** | **Quiz - 1 No.** |
| **Marks (Out of 50)** | **30** | **10** | **10** |
| Remember |  |  |  |
| Understand |  |  |  |
| Apply |  |  |  |
| Analyze |  |  |  |
| Evaluate |  |  |  |
| Create |  |  |  |

**SEE – Semester End Examination Theory (50 Marks) :**

|  |  |
| --- | --- |
| **Bloom’s Category** | **Theory Marks (50)** |
| Remember |  |
| Understand |  |
| Apply |  |
| Analyze |  |
| Evaluate |  |
| Create |  |

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| **ARTIFICIAL INTELLIGENCE & ROBOTICS** |

Course Code : 18EC7DEDAI Credits : 3

L : P : T : S : 3 : 0 : 0 : 0 CIE Marks : 50

Exam Hours : 3 SEE Marks : 50

Total Hours : 50 CIE + SEE : 100

**COURSE OBJECTIVE :**

1. is to impart knowledge of the fundamental concepts of robotics & its mathematical interpretations in 3-dimensional analysis along with applications.
2. to make the student to develop the direct kinematic model for successful robotic manipulation to do a PNP operation.
3. is to find out all the possible solutions to solve the inverse kinematic problem.
4. is to develop the student’s knowledge in various robot structures to work effectively in its workspace.
5. is to make the robotic system to follow a well-defined trajectory from source to destination during manipulation.
6. of this module is to introduce the basic principles, techniques, state of art techniques in AI & its applications with different types of learning approaches used for different applications.

**COURSE OUTCOMES:**

At the end of the course, student will be able to

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| **CO1** | Remember the basic structure of robots with their mathematical interpretations in the 3-dimensional analysis. |
| **CO2** | Understand the kinematic analysis while doing the PNPO. |
| **CO3** | Apply the knowledge of mathematics in developing all possible solutions to the inverse kinematic analysis while doing the PNPO. |
| **CO4** | Analyze the area in which the robot can do the effective PNPO with a well-defined optimized shortest path trajectory. |
| **CO5** | Evaluate the performance of difference learning schemes used for solving a typical robotic application using AI concepts. |
| **CO6** | Create a typical robotic application to solve any type of automated works without human intervention. |

**Mapping of Course Outcomes to Program Outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 1 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 2 | 1 | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 2 | 2 | 1 | - | - | - | - | - | - | - | - |
| **CO4** | 3 | 2 | 2 | 1 | - | - | - | - | - | - | - | - |
| **CO5** | 3 | 3 | 2 | 2 | - | - | - | 1 | 1 | - | - | - |
| **CO6** | 3 | 1 | - | - | - | - | - | - | - | - | - | - |

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| **Module** | **Course Content** | **Hours** | **CO’s** |
| 1 | Introduction to robots & robotic manipulation Automation, Types of automation, Robots, Definition of Robot, Robotics, Laws of Robotics, Robotic Manipulator, Robot Anatomy, Robot Programming, Robot classification, Robot Specifications, Sensors in robots, Applications of robots, Mathematical notations & symbols, Dot & Cross products, Orthogonality & Orthonormality, Coordinate Frames, Coordinate Transformations, Rotation Matrices (RM-Fundamental & Composite), Homogeneous Coordinate Transformation Matrices (HCTM-Fundamental & Composite), Inverse matrices, Screw Transformation Matrices (STM), Case studies, Problems. | 08 | CO1  CO6 |
| 2 | Robot Direct / Forward Kinematics Introduction to robot arm direct kinematics & its types, Definition, Direct kinematics, Block-Diagrammatic representation of DK, Approaches to DK problem, Kinematic parameters (Joint & Link parameters), General Link Coordinate Transformation matrix, Arm matrix & arm equation, Link Coordinate Diagram (LCD), Kinematic Parameter Table (KPT), Denavit Hartenberg Representation, DK analysis of 2 axis, 3 axis, 4 axis robots, Case studies, Problems. | 08 | CO2  CO3 |
| 3 | Robot Inverse / Backward Kinematics Introduction to robot inverse kinematics problems, Definition of IK, Uniqueness of IK solutions, Properties of solutions, Block-Diagrammatic representation, Approaches to IK problem, Relation between DK & IK, Tool Configuration & its Space (TCS), Joint Space (JS), Tool Configuration Vector (TCV), Inverse kinematic analysis of 2 axis, 3 axis, 4 axis robots, Case studies, Problems. | 08 | CO2  CO3 |
| 4 | **Robot Work Space Analysis & Trajectory Planning**  Work space, Work space envelope, Joint space work envelope, Dexterous work envelope, total work envelope, Work space analysis of 2 axis, 3 axis, 4 axis, Path, Trajectory, Shape of trajectory, Speed distribution functions, Types of robot motions, Pick & Place trajectory, Continuous path motion trajectory, Straight line motion trajectory, Interpolated motion trajectory, Parabolic blends, Case studies, Problems. | 08 | CO4 |
| 5 | **Artificial Intelligence & AI based robot task planning**  Robotics & AI, Natural & Artificial Intelligence, Goals & Tenets of AI, Applications of AI, Swarm Intelligence, Imitation learning, Multi agent learning, Supervised learning, Unsupervised learning, Reinforcement learning, Deep learning, ANNs, CNNs, RNNs, NLP, Speech Recognition, Pattern Recognition & Robot Computer Vision, Cognitive Sciences, Task, Planning, Robot task planners, Robot motion planning techniques, Gross motion planning, Fine motion planning, Grasp planning, Motion heuristics, Simulation of planar motions, Future of Robotics, Research future trends in AI, Autonomous vehicles, Application to Chandrayan & Mars Rovers, Case studies, Problems. | 08 | CO5  CO6 |

**NOTE:**

1. Questions for CIE and SEE not to be set from self-study component.

2. Assignment Questions should be from self-study component only.

**Self-Study Components:**

UNIT 1 : Components of robots, Construction of robots, Industrial applications in manufacturing sector.

UNIT 2 : Simulation studies of direct kinematic analysis for different cases with the development of mini-projects (h/w or s/w based).

UNIT 3 : Simulation studies of inverse kinematic analysis for different cases with development mini-projects (h/w or s/w based).

UNIT 4 : Simulation studies of work space fixtures & types of interpolated motions with cubic polynomials for different cases with development of mini-projects (h/w or s/w based).

UNIT 5 : Simulation studies of AI & its goals for performing automated path planning w/o human interventions with development of mini-projects (h/w or s/w based).

**TEXT BOOKS :**

1. Dr. T.C.Manjunath, “Fundamentals of Robotics”, Vol. 1 & Vol. 2, *Nandu Publishers*, 5th Edn., Mumbai, Maharashtra, India,2005.
2. Robert J. Schilling, “Fundamentals of Robotics”, *Prentice Hall Inc*., 3rd Edn., New Delhi, India, 2010.
3. Elaine Rich & Kevin Knight, “Artificial Intelligence”, Mac Graw Hill, Singapore, 3rd Edn., 2017.

**REFERENCES :**

1. Dr. T.C.Manjunath, “Fast Track to Robotics”, *Nandu Publishers*, 2nd Edn., Mumbai, Maharashtra, India,2005.
2. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, “Robotics: Control Sensing Vision & Intelligence”, *Mac Graw Hill*, USA, 5th Edition, 2010.
3. Robin R. Murphy, “Introduction to AI and Robotics”, *MIT Press*, Second Edition, ISBN: 9780262038485, 648 pp., October 2019.

**Scheme of Evaluation of the CIE & Assessment Pattern :**

**Assignment :** Only one assignment (open book test normally) will be of 10 marks & conducted in the class during the course of the semester (normally midway thro’ the semester or in between 2nd & 3rd test). Generally, 2- 4 questions can be given which has to be solved in 1 hour duration, the assignment question has to be from the self-study component or it can be a coding demo or a simulation study using any type of software done in the laptop & shown on the spot to the teacher in the class.

**Quiz :** There will be 1 quiz of 30 questions of 1 marks each, which will be reduced to 10 marks, which may be conducted along with the 2nd CIE test or at the appropriate time during the course of the semester.

**CIE :** There will be 3 CIE tests in a semester conducted for 50 marks with 10 Marks MCQs, remaining 40 Marks descriptive (with theory & problems), each of 10 Marks, each CIE will be reduced to 10 Marks and totalled up for 30 Marks. There will be choices in the descriptive questions.

**CIE – Continuous Internal Evaluation Theory (50 Marks) :**

|  |  |  |  |
| --- | --- | --- | --- |
| **Bloom’s Category** | **Tests - 3 CIEs** | **Assignment - 1 No.** | **Quiz - 1 No.** |
| **Marks (Out of 50)** | **30** | **10** | **10** |
| Remember | 5 | 1 | 1 |
| Understand | 5 | 2 | 2 |
| Apply | 5 | 2 | 2 |
| Analyze | 5 | 2 | 2 |
| Evaluate | 5 | 2 | 2 |
| Create | 5 | 1 | 1 |

**SEE – Semester End Examination Theory (50 Marks) :**

|  |  |
| --- | --- |
| **Bloom’s Category** | **Theory Marks (50)** |
| Remember | 7 |
| Understand | 9 |
| Apply | 9 |
| Analyze | 9 |
| Evaluate | 9 |
| Create | 7 |

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| **ASIC DESIGN** |

**Course Code :** 18EC7DEDAD **Credits :** 04

**L : P : T : S :** 4 : 0 : 1 : 0  **CIE Marks :** 50

**Exam Hours :** 03 **SEE Marks :** 50

**Total Hours :** 50 **CIE + SEE :** 100

**Course Objectives:**

* To learn the types, internal architecture and construction of ASICs.
* To study the architectural details of FPGA’s and programming ASIC design on FPGA
* To understand the ASIC library design and construction.

**Course Content:**

**Module-1**

Introduction to ASICs: Types of ASICs-Full Custom with ASIC, Semi-custom ASICS, Standard Cell based ASIC, Gate array based ASIC, Channeled gate array, Channel less gate array, structured get array, Programmable logic device, FPGA, Design flow, ASIC cell libraries.

Data Logic Cells: Data Path Elements, Adders, Multiplier, Arithmetic Operator, I/O cell, Cell Compilers. 08 Hours

**Module-2**

ASIC Library Design: Logical effort: practicing delay, logical area and logical efficiency, logical paths, multi stage cells, optimum delay, optimum no. of stages, library cell design, CAD Tools. Low-Level Design Entry: Schematic Entry: Hierarchical design. The cell library, Names, schematic, Icons & Symbols, Nets, schematic entry for ASIC’S, connections, vectored instances and buses, Edit in place, attributes, Net list screener, Schematic-Entry tools Back annotation. 08 Hours

**Module-3**

Programmable ASICs: The Ant fuse, EPROM and EEPROM Technology, Practical Issues, Specifications

Programmable ASICs logic cells: Actel ACT, Xilinx LCA, Altera FLEX, Altera MAX

Programmable ASIC I/O cells: DC output, AC output, DC input, AC input, Clock input, Power input, Xilinx I/O Block, other I/O cells. 08 Hours

**Module-4**

Programmable ASIC Interconnect: Actel ACT routing resources, Elmore’s constant, Delay RC delay in anti-fuse connections, anti-fuse parasitic capacitance.

A Brief Introduction to Low Level Design Language: an introduction to EDIF, PLA Tools, an introduction to CFI designs representation. Half gate ASIC. Introduction to Synthesis and Simulation. 08 Hours

**Module-5**

ASIC Construction Floor Planning and Placement and Routing: Physical Design, System Partitioning, Estimating ASIC size, partitioning methods. Floor planning tools, I/O and power planning, clock planning, placement algorithms, iterative placement improvement, Time driven placement methods. Physical Design flow global Routing, Local Routing, Detail Routing, Special Routing, Circuit Extraction and DRC.

08 Hours

**Course Outcomes:**

At the end of course, students will be able to

1. To study types of ASICs and their structure.
2. To design cell library and ASICs with combinational blocks, memory cell and sequential circuits.
3. To analyze the characteristics of Programmable ASIC I/O cells.
4. To understand the concept of floor planning, routing and IO interconnects.

**Reference Books:**

1. M.J.S .Smith, - “Application - Specific Integrated Circuits” – Pearson Education, 2003.

2. Andrew Brown, - “VLSI Circuits and Systems in Silicon”, McGraw Hill, 1991.

3. S.D. Brown, R.J. Francis, J. Rox, Z.G. Uranesic, “Field Programmable Gate Arrays”-

Kluwer Academic Publishers, 1992.

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| **FIBER OPTIC COMMUNICATIONS** |

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| --- | --- |
| **Course Code :** 18EC7DEDFC  **L : P : T : S :** 3 : 0 : 0 : 0  **Exam Hours :** 3  **Total Hours :** 40 | **Credits :** 03  **CIE Marks :** 50  **SEE Marks :** 50  **SEE + CIE :** 100 |

**COURSE OBJECTIVES:**

1. Impart the knowledge of optical transmission and reception system and the various losses involved.
2. Impart the technicalities of the optical components, such as sources, detectors splices and connectors.
3. Grasp the technique of analog and digital link, their parameters and calculate the link and rise time budgets.
4. Analyze the multiplexing concepts and the use of various optical passive and active components.
5. Impart the technical knowhow of advanced optical amplifiers and optical networks.

**COURSE OUTCOMES:**

At the end of the course, student will be able to

|  |  |
| --- | --- |
| CO1 | Attain knowledge of types of Optical Fiber Communication and their significance in today’s world. |
| CO2 | Obtain the knowledge of components in an Optical Communication system, such as sources, detectors splices and connectors. |
| CO3 | Be able to Design an analog and digital optical link and arrive at the link and rise time budgets. |
| CO4 | Assimilate the optical multiplexing concept and the use of various optical passive and active components in a network. |
| CO5 | Acquire technical knowhow of advanced optical amplifiers. |
| CO6 | Acquire the concepts of optical networking. |

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | **Overview of optical fiber communication and the losses involved**  Overview of optical fiber communication:Introduction, Historical development, general system, advantages, disadvantages, and applications of optical fiber communication, optical fiber waveguides, Ray theory, cylindrical fiber, Attenuation, absorption, bending loss, dispersion, Intra model dispersion, Inter model dispersion, scattering losses. | 8 | CO1 |
| 2 | **Optical Sources, Detectors, Splices and Connectors.**  Optical sources: introduction, LED’s, structure, quantum efficiency and LED power. Lasers, Fabry Perot laser, rate equation.  **Photo detectors:** PIN, Avalanche photodiodes, Photo detector noise, Response time, Fiber alignment and joint loss, single mode fiber joints, fiber splices, fiber connectors and fiber couplers. | 8 | CO2 |
| 3 | **Analog and Digital Links:**  Analog links: overview of analog links, CNR (carrier power, Photo detector and preamplifier noises, relative intensity noise) Multichannel transmission techniques  **Digital links:** Introduction, point–to–point links, System considerations Link power budget, rise time budget, | 8 | CO3 |
| 4 | **WDM concepts**:  WDM concepts, overview of WDM operation principles, WDM standards, Mach- Zehender interferometer multiplexer, Isolators and circulators, direct thin film filters, active optical components, MEMS technology, variable optical attenuators, tunable optical filters, dynamic gain equalizers, optical drop multiplexers, polarization controllers, chromatic dispersion compensators, tunable light sources. | 8 | CO4  CO5 |
| 5 | **Optical Amplifiers and Networks**:  Optical Amplifiers: Basic Application and Types, Semiconductor Optical Amplifier, Optical Networks: Introduction, SONET/SDH, Optical interfaces, SONET/SDH Rings, High Speed Light Waveguides. | 8 | CO5 |

**NOTE:**

1. Questions for CIE and SEE not to be set from self-study component.

2. Assignment Questions should be from self-study component only.

**SELF STUDY COMPONENTS:**

UNIT 1 : Fiber materials, photonic crystal, Fiber fabrication, fiber optic cables, specialty fibers, cut-off wavelength, Mode field Diameter.

UNIT 2 : Surface and Edge emitting LEDs, light source materials

UNIT 3 : RF over fiber, Key link parameters, radio over fiber links, Microwave photonics.

UNIT 4 : WDM Standards

UNIT 5 : Optical interfaces, High Speed Light Waveguides.

**TEXT BOOKS:**

1. Optical Fiber Communication, Gerd Keiser, 4th Ed., *MGH*, 2008.

2. Optical Fiber Communications, John M. Senior, *Pearson Education*, 3rd Impression, 2007.

**REFERENCES:**

1. Fiber Optic Communication, Joseph CB, Palaise: 4th edition, Pearson Education.

**Scheme of Evaluation of the CIE & Assessment Pattern :**

**Assignment :** Only one assignment (open book test normally) will be of 10 marks & conducted in the class during the course of the semester (normally midway thro’ the semester or in between 2nd & 3rd test). Generally, 2- 4 questions can be given which has to be solved in 1 hour duration, the assignment question has to be from the self-study component or it can be a coding demo done in the laptop & shown on the spot to the teacher in the class.

**Quiz :** There will be 1 quiz of 30 questions of 1 marks each, which will be reduced to 10 marks, which may be conducted along with the 2nd CIE test or at the appropriate time during the course of the semester.

**CIE :** There will be 3 CIE tests in a semester conducted for 50 marks with 10 Marks MCQs, remaining 40 Marks descriptive (with theory & problems), each of 10 Marks, each CIE will be reduced to 10 Marks and totalled up for 30 Marks. There will be choices in the descriptive questions.

**CIE – Continuous Internal Evaluation Theory (50 Marks) :**

|  |  |  |  |
| --- | --- | --- | --- |
| **Bloom’s Category** | **Tests -3 CIEs** | **Assignment - 1 No.** | **Quiz - 1 No.** |
| **Marks (Out of 50)** | **30** | **10** | **10** |
| Remember | 10 | 4 |  |
| Understand | 10 | 4 |  |
| Apply | 5 | 2 |  |
| Analyze | 5 |  |  |
| Evaluate |  |  |  |
| Create |  |  |  |

**SEE – Semester End Examination Theory (50 Marks) :**

|  |  |
| --- | --- |
| **Bloom’s Category** | **Theory Marks (50)** |
| Remember | 10 |
| Understand | 20 |
| Apply | 5 |
| Analyse | 5 |
| Evaluate | 5 |
| Create | 5 |

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| **MICROWAVE ENGINEERING** |

**Course Code :** 18EC7DEEME **Credits :03**

**L : P : T : S :**  3: 0: 0: 0  **CIE Marks :** 50

**Exam Hours :** 03 **SEE Marks :** 50

**Total Hours : 40 CIE + SEE :** 100

**COURSE OBJECTIVES:**

1. To understand and analyze the basics of the transmission lines, waveguide.
2. To analyze the transmission line characteristics using smith chart and S-Parameters.
3. To understand plane waves and develop field expressions for the same.
4. To understand the basics of microwave devices.
5. To analyze the parameters of microwave passive devices.
6. To summarize the working of various microwave devices.

**COURSE OUTCOMES:**

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

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| --- | --- |
| **CO1** | Apply the knowledge of electromagnetics to develop expressions for waves. |
| **CO2** | Apply the knowledge of network and wave theory to develop expressions for transmission lines. |
| **CO3** | Illustrate the working of various microwave devices. |
| **CO4** | Analyse and solve for various parameters related to transmission lines, microwave devices, |
| **CO5** | Analyse various parameters related to Strip lines. |
| **CO6** | Summarise the working principle of Radar. |

**Mapping of Course outcomes to Program outcomes:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 1 | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 3 | 1 | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 2 | 1 | - | - | - | - | - | - | - | - | - |
| **CO4** | - | 3 | 2 | - | - | - | - | - | - | - | - | - |
| **CO5** | - | 3 | 2 | - | - | - | - | - | - | - | - | - |
| **CO6** | 3 | - | - | - | - | - | - | - | - | - | - | - |

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| --- | --- | --- | --- |
| **Module** | **Contents of the Module** | **Hours** | **COs** |
| 1 | **UNIT - 1**  **MICROWAVE TRANSMISSION LINES:** Introduction, transmission lines equations and solutions, reflection and transmission coefficients, standing waves and SWR, line impedance and line admittance. Smith chart, impedance matching using single stubs, Microwave coaxial connectors. | 8 |  |
| 2 | **MICROWAVE WAVEGUIDES AND COMPONENTS:** Introduction, rectangular waveguides, circular waveguides, microwave cavities, microwave hybrid circuits, directional couplers, circulators and isolators. Introduction, Microstrip lines, Parallel strip lines, Coplanar strip lines, Shielded strip Lines. | 8 |  |
| 3 | **MICROWAVE DIODES:**  Transfer electron devices: Introduction, GUNN effect diodes – GaAs diode, RWH theory, Modes of operation, Avalanche transit time devices: READ diode, IMPATT diode, BARITT diode, Parametric amplifiers Other diodes: PIN diodes, Schottky barrier diodes. | 8 |  |
| 4 | **Microwave network theory and passive devices**: Symmetrical Z and Y parameters, for reciprocal Networks, S matrix representation of multi port networks. Microwave passive devices, Coaxial connectors and adapters, Phase shifters, Attenuators, Waveguide Tees, Magic tees. | 8 |  |
| 5 | **AN INTRODUCTION TO RADAR:** Basic Radar, The simple form of the Radar equation, Radar block diagram, Radar frequencies, application of Radar, the origins of Radar. Introduction to Doppler and MTI Radar, delay line Cancellers, digital MTI processing, Moving target detector, pulse Doppler Radar | 8 |  |

**Note:**

1. Questions for CIE and SEE not to be set from self-study component.

2. Assignment Questions should be from self-study component only.

\* Qualitative analysis only

TEXT BOOKS:

1. Microwave Devices and circuits- Liao / Pearson Education.

2. Introduction to Radar systems-Merrill I Skolnik, 3rd Ed, TMH, 2001.

3. Microwave Engineering – Annapurna Das, Sisir K Das TMH Publication, 2nd , 2010.

REFERENCE BOOK:

1. Microwave Engineering – David M Pozar, John Wiley India Pvt Ltd., 3rd Edn, 2008.

**Scheme of Evaluation of the CIE & Assessment Pattern :**

**Assignment :** Only one assignment (open book test normally) will be of 10 marks & conducted in the class during the course of the semester (normally midway thro’ the semester or in between 2nd & 3rd test). Generally, 2- 4 questions can be given which has to be solved in 1 hour duration, the assignment question has to be from the self-study component or it can be a coding demo done in the laptop & shown on the spot to the teacher in the class.

**Quiz :** There will be 1 quiz of 30 questions of 1 marks each, which will be reduced to 10 marks, which may be conducted along with the 2nd CIE test or at the appropriate time during the course of the semester.

**CIE :** There will be 3 CIE tests in a semester conducted for 50 marks with 10 Marks MCQs, remaining 40 Marks descriptive (with theory & problems), each of 10 Marks, each CIE will be reduced to 10 Marks and totalled up for 30 Marks. There will be choices in the descriptive questions.

**CIE – Continuous Internal Evaluation Theory (50 Marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Bloom’s Category** | **Tests - 3 CIEs** | **Assignment - 1 No.** | **Quiz - 1No.** |
| Marks (Out of 50) | 30 | 10 | 10 |
| Remember |  |  |  |
| Understand | 10 | 02 |  |
| Apply | 10 | 03 |  |
| Analyze | 10 | 05 |  |
| Evaluate |  |  |  |
| Create |  |  |  |

**SEE –Semester End Examination Theory (50 Marks):**

|  |  |
| --- | --- |
| **Bloom’s Category** | **Marks Theory (50)** |
| Remember | 10 |
| Understand | 10 |
| Apply | 15 |
| Analyze | 15 |
| Evaluate |  |
| Create |  |

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| --- | --- |
| **INTRODUCTION TO MEMS & NEMS** | |
| **Course Code :** 18EC7DEEMN  **L : P : T : S :** 3 : 0 : 0 : **0**  **Exam Hours :** 3  **Total Hours :** 40 | **Credits :** 03  **CIE Marks :** 50  **SEE Marks :** 50  **CIE + SEE Marks :** 100 |

**COURSE OBJECTIVES**

This course will enable students to know about ….

1. Ability to understand the operation of micro devices, micro systems and their applications
2. Ability to understand about the transduction, actuation and overall microsystems.
3. Gain a knowledge of basic approaches for various sensor design.
4. Learn about the fabrication techniques of MEMS
5. Gain the impact of scaling on MEMS systems.
6. Gain the technical knowledge required for characterization of Nano-structured materials, micro- and Nano-scale devices.

**COURSE OUTCOMES:**

The student will be able to

|  |  |
| --- | --- |
| **CO1** | After studying this course, students will be able to : Know the interdisciplinary nature of MEMS design. |
| **CO2** | Appreciate the technologies related to Micro Electro Mechanical Systems. |
| **CO3** | Understand design and fabrication processes involved with MEMS devices. |
| **CO4** | Know various application areas for MEMS devices |
| **CO5** | Know various application areas for NEMS devices |
| **CO6** | Designing of MEMS devices & using it for some application |

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| **Module** | **Content of the Module** | **Hours** | **COs** |
| 1 | **Overview of MEMS & Microsystems :** MEMS & Microsystems, Typical MEMS and Micro system products — features of MEMS, The multidisciplinary nature of Microsystems design and manufacture, Applications of Microsystems in automotive industry, health care industry, aerospace industry, industrial products, consumer products and telecommunications. | 08 | CO1 |
| 2 | **Working Principles of Microsystems:** Introduction, Micro sensors, Micro actuation, MEMS with Micro actuators, Micro accelerometers, Microfluidics.  Engineering Science for Microsystems Design and Fabrication: Introduction, Molecular Theory of Matter and Inter-molecular Forces, Plasma Physics, Electrochemistry. | 08 | CO2 CO3 |
| 3 | **Electronic Circuits and control of micro systems:** Introduction to semiconductor devices, Semiconductor diode, thermistor, Bipolar Junction transistor and MOSFET, Optical Sensor devices.  Transduction Principles in MEMS & Microsystems: Micro actuation using thermal forces, piezo eclectic and electrostatic forces, MEMS with micro actuators- Micromechanical Motors and pumps | 08 | CO3CO4 |
| 4 | **Scaling Laws in Miniaturization:** Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Electricity.  Overview of Micro manufacturing : Introduction, Bulk Micro manufacturing, Surface Micromachining, the LIGA Process, Summary on Micro manufacturing. | 08 | CO3  CO4 CO6 |
| 5 | **Nanosystems & Quantum Mechanics :** Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wave function Theory, Density Functional Theory. Trends in Quantum Physics and NEMS. Applications | 08 | CO4  CO5 |

**TEXT BOOK** :

1. Tai-Ran Hsu, “MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering”, 2nd Ed, *Wiley*.

2. G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat, V.K. Aatre, “Micro and Smart Systems Technology and Modeling”, *Indian Institute of Science*, Bangalore.

**REFERENCE BOOKS:**

1. Sergey Edward Lyshevski , “Nano & Micro Electro Mechanical Systems - Fundamentals of Nano- and Micro engineering”, *CRC Press*.

**PRE-REQUISITE :** Basics of Analog and Digital VLSI design.

**Scheme of Evaluation of the CIE & Assessment Pattern :**

**Assignment :** Only one assignment (open book test normally) will be of 10 marks & conducted in the class during the course of the semester (normally midway thro’ the semester or in between 2nd & 3rd test). Generally, 2- 4 questions can be given which has to be solved in 1 hour duration, the assignment question has to be from the self-study component or it can be a coding demo done in the laptop & shown on the spot to the teacher in the class, the questions has to be set according to easy, medium, tough & severe and evaluation to be done as per the assignment evaluation rubrics.

**Quiz :** There will be 1 quiz of 10 questions of multiple choice of 1 marks each, which may be conducted along with the 2nd CIE test and written in the answer booklet at the end.

**CIE :** There will be 3 CIE tests in a semester conducted for 50 marks each with 10 Marks MCQs, remaining 40 Marks descriptive (with theory & problems) & finally each CIE will be reduced to 10 Marks and totaled up for 30 Marks and then rounded off to the nearest integer. There has to be choices in the descriptive questions & the questions has to be set module/unit-wise.

|  |  |  |  |
| --- | --- | --- | --- |
| **Bloom’s Category** | **Tests - 3 CIEs** | **Assignments - 1 No.** | **QUIZ - 1 No.** |
| **Marks (Out of 50)** | **30** | **10** | **10** |
| Remember | 10 |  |  |
| Understand | 05 | 05 | 04 |
| Apply | 10 | 05 | 03 |
| Analyze | 05 |  | 03 |
| Evaluate |  |  |  |
| Create |  |  | 03 |

**SEE – Semester End Examination Theory (50 Marks)**

|  |  |
| --- | --- |
| **Bloom’s Category** | **Marks Theory (50)** |
| Remember | 10 |
| Understand | 10 |
| Apply | 15 |
| Analyze | 15 |
| Evaluate | - |
| Create | - |

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| **SYSTEM VERILOG FOR VERIFICATION** |

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| --- | --- |
| **Course Code :** 18EC7DEESV  **L : P : T : S :** 3 : 0 : 0 : **0**  **Exam Hours :** 3  **Total Hours :** 50 | **Credits :** 3  **CIE Marks :** 50  **SEE Marks :** 50  **CIE + SEE :** 100 |

**COURSE OBJECTIVES:**

1. To understand the importance of verification in VLSI design process.
2. To acquire the knowledge of verification constructs available in System Verilog
3. To recognise various verification tools.
4. To analyze different levels of verification
5. To design layered test bench components.
6. To create verification environment using System Verilog

**COURSE OUTCOMES:**

At the end of the course, student will be able to

|  |  |
| --- | --- |
| **CO1** | Appreciate the significance of design verification in VLSI design process |
| **CO2** | Apply System Verilog constructs for verifying the design. |
| **CO3** | Use different tools for verification |
| **CO4** | Analyze different levels of verification |
| **CO5** | Design test bench components using SV. |
| **CO6** | Create verification environment using System Verilog |

**Mapping of Course Outcomes to Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 3 | 3 | 3 | 1 | 1 | - | - | 1 | 1 | 1 | 2 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 3 | - | - | 1 | 1 | 1 | 2 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 3 | - | - | 1 | 1 | 1 | 2 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 3 | - | - | 1 | 1 | 1 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 3 | - | - | 1 | 1 | 1 | 2 |
| **CO6** | 3 | 3 | 3 | 3 | 3 | 3 | - | - | 1 | 1 | 1 | 2 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Module** | **Course Content** | **Hours** | **CO’s** |
| 1 | **Importance of Design Verification:** Define verification and test bench. The importance of verification, Re-convergence model, Formal verification, Functional verification, Black box verification, white box verification, grey box verification. Testing versus verification: Verification Tools:Linting tools: Limitations of linting tools, linting Verilog source code, linting VHDL source code, Simulators: Stimulus and response, Event based simulation, cycle based simulation, Co-simulators, hardware modelers, waveform viewers, Verification languages. | 10 | CO1,CO3 |
| 2 | **Verification Guidelines:** Introduction, Verification guidelines, layered test bench, Simulation environment phases, Maximum code reuse, test bench performance, Built-in Data Types, Fixed-Size Arrays, Dynamic Arrays, Queues, Associative Arrays, Linked Lists, Array Methods, Choosing a Storage Type, Creating New Types with type def, Creating User-Defined Structures, Enumerated Types, Constants, Strings, Expression Width. | 10 | CO2,  CO4 |
| 3 | **Procedural statements and routines:** Introduction, Procedural Statements, Tasks, Functions, and Void Functions, Task and Function Overview, Routine Arguments, Returning from a Routine, Local Data Storage, Time Values.Connecting the test bench and design: Introduction, Separating the test bench and Design, The Interface construct, Stimulus timing interface, driving and sampling, Connecting it all together, Top-Level Scope. | 10 | CO2, CO3 |
| 4 | **BASIC OOP :** Introduction, Think of Nouns, not Verbs, Define a Class, OOP Terminology, Creating New Objects Object De-allocation, Using Objects, Static Variables vs. Global Variables, Class Routines, Defining Routines Outside of the Class, Scoping Rules Using One Class Inside Another, Understanding Dynamic Objects Copying Objects, Public vs. Private Contents, Straying Off Course, Building a Test bench. Test bench codes for digital blocks-Simulation with open source EDA tools | 10 | CO2, CO5 |
| 5 | **Randomization:** Introduction, what to randomize, randomization in SV, constraint details, controlling multiple constraint blocks, Random number functions, common randomization problems, Iterative and array constraints, atomic stimulus generation vs scenario generation, Random control.  Test bench codes for digital blocks-Simulation with open source EDA tools | 10 | CO2, CO6 |

**NOTE:**

1. Questions for CIE and SEE not to be set from self-study component.

2. Assignment Questions should be from self-study component only.

**Self-Study Components:**

Module 1: Code Coverage, FSM coverage, Functional coverage: Item Coverage,

cross coverage, Transition coverage,

Module 2: Packages, Type conversion, Straming operators

Module 3: System Verilog assertions, The Four-Port ATM Router.

Module 4: Advanced OOP and test bench guidelines.

Module 5: Random number generators, Random device configuration

**TEXT BOOKS:**

1. Janick Bergeron, “Writing testbenches: functional verification of HDL models”, 2nd edition, Kluwer Academic Publishers,2003
2. Christian B Spear, “ System Verilog for Verification: A guide to learning the Testbench language features”, Springer publications, 3rd edition,2006

**REFERENCES:**

**1.** S.Sutherland, S. Davidmann and P. Flake, “System Verilog for Design”, 2nd Edition, Springer, 2006.

2. Prakash Rashinkar, Peter Paterson, Leena Singh “System on a Chip Verification”, Kluwer Publications,1st edition,2002.

**Scheme of Evaluation of the CIE & Assessment Pattern :**

**Assignment :**Only one assignment (open book test normally) will be of 10 marks & conducted in the class during the course of the semester (normally midway thro’ the semester or in between 2nd& 3rd test). Generally, 2- 4 questions can be given which has to be solved in 1 hour duration, the assignment question has to be from the self-study component or it can be a coding demo done in the laptop & shown on the spot to the teacher in the class.

**Quiz :**There will be 1 quiz of 30 questions of 1 marks each, which will be reduced to 10 marks, which may be conducted along with the 2nd CIE test or at the appropriate time during the course of the semester.

**CIE :** There will be 3 CIE tests in a semester conducted for 50 marks with 10 Marks MCQs, remaining 40 Marks descriptive (with theory & problems), each of 10 Marks, each CIE will be reduced to 10 Marks and totalled up for 30 Marks. There will be choices in the descriptive questions.

**CIE – Continuous Internal Evaluation Theory (50 Marks) :**

|  |  |  |  |
| --- | --- | --- | --- |
| **Bloom’s Category** | **Tests - 3 CIEs** | **Assignment - 1 No.** | **Quiz - 1 No.** |
| **Marks (Out of 50)** | **30** | **10** | **10** |
| Remember | 5 | 2 | 2 |
| Understand | 5 | 2 | 1 |
| Apply | 5 | 1 | 2 |
| Analyze | 3 | 2 | 2 |
| Evaluate | 2 | 1 | 2 |
| Create | 10 | 2 | 1 |

**SEE – Semester End Examination Theory (50 Marks) :**

|  |  |
| --- | --- |
| **Bloom’s Category** | **Theory Marks (50)** |
| Remember | 10 |
| Understand | 10 |
| Apply | 10 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 10 |

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| **CRYPTOGRAPHY AND NETWORK SECURITY** |

**Course Code:** 18EC7DEECS **Credits:** 03

**L : P : T : S :** 3 : 0 : 0 : 0 **CIE Marks :** 50

**Exam Hours:** 03 **SEE Marks :** 50

**Total Hours:** 40 **CIE + SEE Marks :** 100

**COURSE OBJECTIVES:**

1. To understand basics fundamentals of Cryptography and Network Security.
2. To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
3. To understand the various key distribution and management schemes.
4. To understand various protocols for network security to protect against the threats in the networks.
5. To design security applications in the field of Information technology.

**COURSE OUTCOMES:**

After completion of the course, the graduates will be able to

|  |  |
| --- | --- |
| **CO1** | Identify different security attacks, Mechanisms and services. |
| **CO2** | Analyze the different Block Ciphers & Public Key Cryptography algorithms. |
| **CO3** | Differentiate the various standard Algorithms for authentication techniques. |
| **CO4** | Analyze Internet based secured transactions focusing on Intrusion detection and management. |
| **CO5** | Examine the security concepts related to e-mail, IP & Web security. |
| **CO6** | Illustrate the various security Algorithms using modern tools |

|  |  |  |  |
| --- | --- | --- | --- |
| **Module** | **Contents of the Unit** | **Hours** | **COs** |
| 1 | **Introduction**  Attacks, Security Mechanisms & Security Services, and -the OSI security architecture-Network security model-Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques). | 08 | CO1 |
| 2 | **Block Ciphers & Public Key Cryptography**  **Block Ciphers:** Data Encryption Standard-Block cipher principles-block cipher modes of operation-Advanced Encryption Standard (AES).  **Public Key Cryptography:** Principles of public key cryptosystems-The RSA algorithm-Key management - Diffie Hellman Key exchange-Elliptic curve arithmetic-Elliptic curve cryptography. | 08 | CO2 |
| 3 | **Hash Functions and Digital Signatures:**  **Hash Functions:** Authentication requirement – Authentication function – Message Authentication Codes – Hash functions – Security of hash function and MACs –MD5 – SHA.  **Digital Signature:** Digital signatures and authentication protocols – DSS. | 08 | CO3 |
| 4 | **Security Practice & System Security** – Authentication applications – X.509 Authentication services - Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology- Types of Firewalls Intruders – Intrusion detection system- password management – Virus and related threats – Virus Countermeasures – Firewalls design principles – Trusted systems. | 08 | CO4  CO5 |
| 5 | **E-Mail, IP & Web Security:**  **E-mail Security:** Security Services for E-mail-attacks possible through E-mail - establishing keys privacy-authentication of the source-Message Integrity-Non-repudiation-Pretty Good Privacy-  **IP Security:** Overview of IP Security – IP Security Architecture-Authentication Header.  **Web Security:** Web Security Considerations, Security Socket Layer and Transport Layer Security SSL/TLS. | 08 | CO5  CO6 |

**SELF-STUDY COMPONENT:**

Unit 1 : Introduction -Testing for primality -The Chinese remainder theorem- Discrete algorithms

Unit 2 : BLOCK CIPHERS - Triple DES-Blowfish-RC5 algorithm

Unit 3 : Hash Functions and Digital Signatures Hash Functions- HMAC EI Gamal – Schnorr.

Unit 4 : Security Practice & System Security - Firewall designs - SET for E-Commerce Transactions.

Unit 5 : E-Mail, IP & Web Security: S/MIME, client authentication-PKI as deployed by SSL Attacks fixed in v3- Exportability

**TEXT BOOKS:**

1. William Stallings, “Cryptography and Network Security: Principles and Practice”, *Prentice Hall*, 4th edition.
2. Atul Kahate, “Cryptography and Network Security”, 3rd edition.
3. Behourz A. Forouzan, “Data Communications and Networking”.

**REFERENCE MATERIALS:**

1. J.W. Rittiaghouse and William M. Hancok, “Cyber Security Operations Handbook”, *Elsevier’s*.
2. A.J. Menezes, P. Van Oorschot and S. Vanstone, “Handbook of Applied Cryptography”, *CRC Press*, 1997, ISBN: 0-84-938523-7.

**ASSESSMENT PATTERN:**

**CIE – Continuous Internal Evaluation Theory (50 Marks) :**

|  |  |  |  |
| --- | --- | --- | --- |
| **Bloom’s Category** | **Tests - 3 CIEs** | **Assignments - 1 No.** | **AAT - 1 No.** |
| **Marks (Out of 50)** | **30** | **10** | **10** |
| Remember | 10 | 03 | 01 |
| Understand | 10 | 03 | 01 |
| Apply | 05 | 02 | 02 |
| Analyze | 05 | 02 | 02 |
| Evaluate |  |  | 02 |
| Create |  |  | 02 |

**AAT - Alternate Assessment Tool :**  Quiz /Surprise Test / Seminar / Role Play / Group Discussion / Case Study / E-Course Certification / Mini Projects / Developing Products / Building, Models / Paper Presentation / Paper / Poster Publication / Programming Contest / General Science / Technical Quiz / Hackathons / Demonstration / Analysis / Optimization / Comparison of theoretical concepts using modern tools.

**SEE – Semester End Examination Theory (50 Marks) :**

|  |  |
| --- | --- |
| **Bloom’s Category** | **Theory Marks (50)** |
| Remember | 10 |
| Understand | 15 |
| Apply | 10 |
| Analyze | 5 |
| Evaluate | 5 |
| Create | 5 |

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| **ADVANCED COMMUNICATION LAB** |

**Course Code :** 18EC7DLADC **Credits :** 02

**L : P : T : S :** 0 : 2 : 1 : 0 (3 periods lab)  **CIE Marks :** 50

**Exam Hours :** 03 **SEE Marks :** 50

**Total Hours :** 26 **CIE + SEE :** 100

**COURSE OBJECTIVES:**

1. To understand and implement TDM, ASK, FSK, PSK.
2. To analyse QPSK, DPSK and PCM operation.
3. To measure the losses and to calculate the numerical aperture for an Analog Optical Fibre Link.
4. To learn the assembly of Microwave test bench and perform basic measurements.
5. To test the performance of passive Microwave components.
6. To simulate and obtain radiation patterns of Patch, Yagi and Dipole antennas.

**COURSE OUTCOMES:**

At the end of the course, student will be able to

|  |  |
| --- | --- |
| **CO1** | Apply the knowledge of signals and digital communication to Design and demonstrate the digital modulation techniques. |
| **CO2** | Analyze radiation patterns of basic micro strip antennas |
| **CO3** | Examine micro wave devices using Micro strip lines |
| **CO4** | Test the working of microwave communication system. |
| **CO5** | Relate the basic knowledge of optical fibre communication in determining numerical aperture and losses in an optical fibre system. |
| **CO6** | Understand the probability of error computations of coherent digital modulation schemes. |

**Mapping of Course Outcomes to Program Outcomes:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 3 | 2 | 1 | - | 2 | - | - | - | 1 | 1 | - | - |
| **CO2** | 3 | 2 | - | - | - | - | - | - | 1 | 1 | - | - |
| **CO3** | 3 | 2 | - | - | - | - | - | - | 1 | 1 | - | - |
| **CO4** | 3 | 2 | - | - | - | - | - | - | 1 | 1 | - | - |
| **CO5** | 3 | 2 | - | - | - | - | - | - | 1 | 1 | - | - |
| **CO6** | 3 | 2 | - | - | 2 | - | - | - | 1 | 1 | - | - |

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| **Module** | **Expt**  **No.** | **Content of the Lab Module** | | **Hours** | **CO’s** |
| **Experiments performed using discrete components & kits** | | | | | |
| **PART-A** |  | | TDM of two band limited signals | **18** | CO1 |
|  | | ASK generation and detection | CO1 |
|  | | FSK generation and detection | CO1 |
|  | | PSK generation and detection | CO1 |
|  | | Analysis of PCM System | CO1 |
|  | | DPSK generation and detection using kit | CO1 |
|  | | QPSK generation and detection using kit | CO1 |
|  | | Determination of characteristics of a strip line (or Microstrip) directional coupler, Microstrip ring resonator, Microstrip 3 dB power divider. | CO3 |
|  | | Measurement of frequency, guide wavelength, power, VSWR and attenuation in a Microwave test bench. | CO4 |
|  | | Understanding the radiation pattern of Microstrip Dipole, Yagi, Patch antenna by Antenna setup/Simulation | CO2 |
|  | | Measurement of propagation loss, bending loss and numerical aperture for an Analog optical fibre link. | CO5 |
| **Simulation Experiments using SCILAB / MATLAB / Simulink / LabVIEW** | | | | | |
| **PART-B** |  | | Simulate NRZ, RZ, half-sinusoid and raised cosine pulses and generate eye diagram for binary polar signalling. | **8** | CO1 |
|  | | Pulse code modulation and demodulation system. | CO1 |
|  | | Computations of the Probability of bit error for coherent binary ASK, FSK and PSK for an AWGN Channel and Compare Performance. | CO6 |
|  | | Digital Modulation Schemes i) DPSK Transmitter and receiver, ii) QPSK Transmitter and Receiver. | CO1 |

**Assessment Pattern:**

CIE – Continuous Internal Evaluation Lab (50 Marks)

SEE – Semester End Examination Lab (50 Marks)

**Note :** For conduction, record book writing, viva, marks is kept, totalling to 25 marks & there will be 1 CIE test in a semester conducted for 50 marks at the end of the semester & reduced to 25 marks, i.e., 25 + 25 = 50 marks.

|  |  |  |
| --- | --- | --- |
| **Bloom’s Category** | **Performance (Day To Day)** | **Internal Test** |
| **Marks (Out of 50)** | **25** | **25** |
| Remember |  |  |
| Understand |  |  |
| Apply | 05 | 05 |
| Analyze | 10 | 10 |
| Evaluate | 05 | 05 |
| Create | 05 | 05 |

|  |  |
| --- | --- |
| **Bloom’s Category** | **Marks Theory (50)** |
| Remember | - |
| Understand | 5 |
| Apply | 15 |
| Analyze | 10 |
| Evaluate | 10 |
| Create | 10 |

**GPS and its applications**

**No of credits - 3**

|  |  |
| --- | --- |
| .  Contents | Hours |
| Module1  Introduction, Need for GPS, GPS Program History, GPS constellation, GPS Satellite Orbits, GPS satellites, GPS Modernization Program, GPS services, GPS system segments, Types of GPS receivers, other GNSS systems: GLONASS, GALILEO, Indian GPS | 8 hours |
| Module2  Fundamentals of Satellite Navigation , Concept of Ranging Using TOA Measurements, Two-Dimensional Position Determination , Principle of Position Determination Via, Satellite-Generated Ranging Signals, Position Determination Using PRN Codes , Determining Satellite-to-User Range, Calculation of User Position ,Obtaining User Velocity,  GPS signals: C/A Code,P code,C/A code generation , GPS data format, GPS receiver:Basic GPS receiver operations, | 8 hours |
| Module3  Reference Coordinate Systems , Earth-Centered Inertial Coordinate System, Earth-Centered Earth-Fixed Coordinate System, World Geodetic System, time systems UTC,GPS System Time, Navigation and Surveying using GPS | 8 hours |
| Module4  GPS Applications:Civil Navigation Applications of GPS : Marine Navigation, Air Navigation , Land Navigation GPS in Surveying, GPS in Mapping, Geographical Information Systems. | 8 hours |
| Module5  Differential Applications and Services : Precision Approach Aircraft Landing Systems, Attitude Determination Systems, GPS in Telematics and LBS, Government and Military Applications: Military User Equipment—Aviation, Shipboard, and Land ,Autonomous Receivers—Smart Weapons, Space Applications, Government Applications | 8 hours |

Books

1.Understanding GPS Principles and Applications, Elliott D. Kaplan Christopher J. Hegarty, Second Edition, ARTECH HOUSE, INC., 2006, ISBN 1-58053-894-0

2.Introduction to GPS

The Global Positioning System, Ahmed El-Rabbany, Artech House, ISBN 1-58053-183-0