RSET

RAJAGIRI SCHOOL OF ENGINEERING & TECHNOLOGY

# COURSE HAND-OUT

## B.TECH. - SEMESTER VIII

## DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING (EC), RSET

### VISION

TO EVOLVE INTO A CENTRE OF EXCELLENCE IN ELECTRONICS AND COMMUNICATION ENGINEERING, MOULDING PROFESSIONALS HAVING INQUISITIVE, INNOVATIVE AND CREATIVE MINDS WITH SOUND PRACTICAL SKILLS WHO CAN STRIVE FOR THE BETTERMENT OF MANKIND

### MISSION

TO IMPART STATE-OF-THE-ART KNOWLEDGE TO STUDENTS IN ELECTRONICS AND COMMUNICATION ENGINEERING AND TO INCULCATE IN THEM A HIGH DEGREE OF SOCIAL CONSCIOUSNESS AND A SENSE OF HUMAN VALUES, THEREBY ENABLING THEM TO FACE CHALLENGES WITH COURAGE AND CONVICTION

## B.TECH PROGRAMME

**Program Outcomes (POs)**

**Engineering students will be able to**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, Engineering fundamentals, and Electronics and Communication Engineering to the solution of complex Engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze 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 the public health and safety, and the 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 modeling 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 the need for sustainable developments.
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 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.

**Program-Specific Outcomes (PSOs)**

**Engineering students will be able to:**

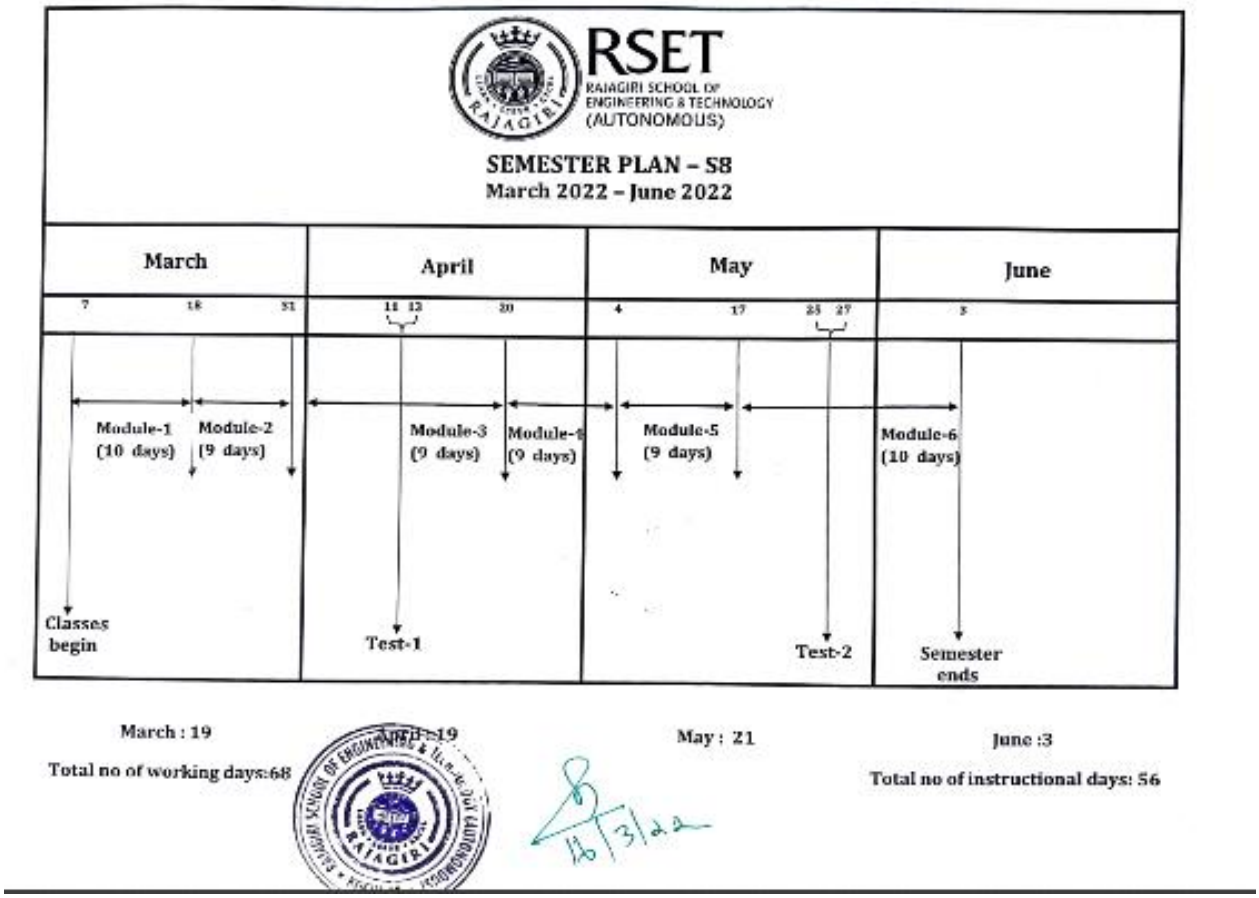
1. Demonstrate their skills in designing, implementing and testing analogue and digital electronic circuits, including microprocessor systems, for signal processing, communication, networking, VLSI and embedded systems applications;

2. Apply their knowledge and skills to conduct experiments and develop applications using electronic design automation (EDA) tools;

3. Demonstrate a sense of professional ethics, recognize the importance of continued learning, and be able to carry out their professional and entrepreneurial responsibilities in electronics engineering field giving due consideration to environment protection and sustainability.

# INDEX

# 1. SEMESTER PLAN



## 2. SCHEME

| SLOT | Code | | Subject | Hours/Week | | | Credits |
|---|---|---|---|---|---|---|---|
| | | | | L | T | P | |
| A | EC 402 | | Nano Electronics | 3 | 0 | 0 | 3 |
| B | EC404 | | Advanced Communication Systems | 3 | 0 | 0 | 3 |
| C | ELECTRIVE 4 | EC468 | Secure Communication | 3 | 0 | 0 | 3 |
| | | EC466 | Cyber Security | | | | |
| D | ELECTIVE 5 | | Non Departmental | 3 | 0 | 0 | 3 |
| S | EC492 | | Project | | | | 6 |

# EC 402

# NANO ELECTRONICS

# COURSE INFORMATION SHEET

| | |
|---|---|
| PROGRAMME: Electronics & Communications Engineering | DEGREE: BTECH |
| COURSE: Nanoelectronics | SEMESTER: S8 CREDITS: 3 |
| COURSE CODE: EC402 REGULATION: 2016 | COURSE TYPE: **CORE**~~/ELECTIVE / BREADTH/ S&H~~ |
| COURSE AREA/DOMAIN: ELECTRONICS | CONTACT HOURS: 4 hours/Week. |
| CORRESPONDING LAB COURSE CODE (IF ANY): | LAB COURSE NAME: |

**SYLLABUS:**

| UNIT | DETAILS | HOURS |
|---|---|---|
| Introduction to nanotechnology, Mesoscopic physics, trends in microelectronics and optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence, Schrodinger's Equation, wave function, Low dimensional structures Quantum wells, Basic properties of two dimensional semiconductor nanostructures, Quantum wires and quantum dots, carbon nano tube, grapheme, Introduction to methods of fabrication of nano-layers, Introduction to characterization of nanostructures, Principle of operation of Scanning Tunnelling Microscope, X-Ray Diffraction analysis, MOSFET structures, Quantum wells, modulation doped quantum wells, multiple quantum wells, The concept of super lattices, Transport of charge in Nanostructures under Electric field, Transport of charge in magnetic field, Nanoelectonic devices, principle of NEMS | | |
| 1 | Introduction to nanotechnology, Impacts, Limitations of conventional microelectronics, Trends in microelectronics and optoelectronics<br><br>Mesoscopic physics, trends in microelectronics and optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence<br><br>Classification of Nano structures, Low dimensional structures Quantum wells, wires and dots, Density of states and dimensionality<br><br>Basic properties of two dimensional semiconductor nanostructures, square quantum wells of finite depth, parabolic and triangular quantum wells<br><br>Quantum wires and quantum dots, carbon nano tube, graphene | 7 |
| 2 | Introduction to methods of fabrication of nano-layers, different approaches, physical vapour deposition, chemical vapour deposition Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide- dry and wet oxidation methods.<br>Fabrication of nano particle- grinding with iron balls, laser ablation, | 6 |

| | | |
|---|---|---|
| | reduction methods, sol gel, self assembly, precipitation of quantum dots. | |
| 3 | Introduction to characterization of nanostructures, tools used for of nano materials characterization, microscope-optical, electron, and electron microscope.<br>Principle of operation of Scanning Tunnelling Microscope, Atomic Force Microscope, Scanning Electron microscope, Specimen interaction. Transmission Electron Microscope<br>X-Ray Diffraction analysis, PL & UV Spectroscopy, Particle size analyser. | 6 |
| 4 | Two dimensional electronic system, two dimensional behaviour, MOSFET structures, Heterojunctions<br>Quantum wells, modulation doped quantum wells, multiple quantum wells<br>The concept of super lattices Kronig - Penney model of super lattice. | 6 |
| 5 | Transport of charge in Nanostructures under Electric field - parallel transport, hot electrons, perpendicular transport.<br>Quantum transport in nanostructures, Coulomb blockade<br>Transport of charge in magnetic field - Effect of magnetic field on a crystal. Aharonov-Bohm effect, the Shubnikov-de Hass effect, the quantum Hall effect | 7 |
| 6 | Nanoelectonic devices- MODFETS, heterojunction bipolar transistors<br>Resonant tunnel effect, RTD, RTT, Hot electron transistors<br>Coulomb blockade effect and single electron transistor, CNT transistors<br>Heterostructure semiconductor laser<br>Quantum well laser, quantum dot LED, quantum dot laser<br>Quantum well optical modulator, quantum well sub band photo detectors, principle of NEMS. | 10 |
| | TOTAL HOURS | 42 |

**TEXT/REFERENCE BOOKS:**

| T/R | BOOK TITLE/AUTHORS/PUBLICATION |
|---|---|
| T | J.M. Martinez-Duart, R.J. Martin Palma, F. Agulle Rueda Nanotechnology for Microelectronics and optoelectronics, Elsevier, 2006 |
| T | W.R. Fahrner, Nanotechnology and Nanoelctronics, Springer, 2005 |
| R | Chattopadhyay, Banerjee, Introduction to Nanoscience & Technology, PHI, 2012 |
| R | George W. Hanson, Fundamentals of Nanoelectronics, Pearson Education, 2009 |
| R | K. Goser, P. Glosekotter, J. Dienstuhl, Nanoelectronics and nanosystems, Springer 2004 |
| R | Murty, Shankar, Text book of Nanoscience and Nanotechnology, Universities Press, 2012 |
| R | Poole, Introduction to Nanotechnology, John Wiley, 2006. |

| | |
|---|---|
| R | Supriyo Dutta, Quantum Transport- Atom to transistor, Cambridge, 2013 |

**COURSE PRE-REQUISITES:**

| C.CODE | COURSE NAME | DESCRIPTION | SEM |
|---|---|---|---|
| EC203 | Solid State Devices | Student should have knowledge of basic semiconductor physics | 3 |
| EC304 | VLSI | Student should have knowledge of basic fabrication techniques in VLSI | 6 |

**COURSE OBJECTIVES:**

| | |
|---|---|
| 1 | To impart knowledge in different aspects of processor design |
| 2 | To develop understanding about processor architecture. |
| 3 | To impart knowledge in programming concepts |
| 4 | To develop understanding on I/O accessing techniques and memory structures |

**COURSE OUTCOMES:**

| Sl No. | DESCRIPTION | BLOOM'S TAXONOMY LEVEL |
|---|---|---|
| 1 | **Understand** the basic concepts of mesophysics and nanostructures | Understand (level 2) |
| 2 | **Understand** about the methods used for fabrication of Nano layers and Nanoparticles | Understand (level 2) |
| 3 | **Understand** about the tools used for characterisation and analysis of Nano materials | Understand (level 2) |
| 4 | **Understand** the concept of 2D behaviour and superlattice | Understand (level 2) |
| 5 | **Understand** about charge transport & quantum transport in nanostructures | Understand (level 2) |
| 6 | **Understand** the working of different nanoelectronic devices | Understand (level 2) |

**CO MAPPING WITH PO, PSO**

| | Programme Outcomes (POs) | | | | | | | | | | | | Programme-Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO No.** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **1** | **3** | **3** | | **2** | **1** | | | | | | | **1** | **2** | | **1** |
| **2** | **2** | **3** | | **2** | **1** | **1** | | | | | | **1** | **2** | | **1** |
| **3** | **3** | **2** | | **2** | **3** | **1** | | | | | | **1** | **1** | | **1** |
| **4** | **3** | **2** | | **3** | | | | | | | | **1** | | | **2** |
| **5** | **3** | **2** | | **3** | | | | | | | | **1** | | | **2** |
| **6** | **2** | **1** | **2** | **2** | **1** | | **1** | | | | | **1** | **3** | **1** | **1** |
| **EC402** | **3** | **2** | **2** | **2** | **2** | **1** | **1** | | | | | **1** | **1** | **1** | **1** |

**JUSTIFICATION FOR CO-PO-PSO CORRELATION:**

## JUSTIFICATION FOR CO-PO MAPPING

| MAPPING | LEVEL | JUSTIFICATION |
|---|---|---|
| EC402.1-PO1 | 3 | Concepts of mesophysics and nanostructures involves applying the knowledge of mathematics, science to find solutions to complex engineering problems |
| EC402.1-PO2 | 3 | Concepts of mesophysics and nanostructures uses the principles of mathematics, natural sciences and engineering sciences for analysis |
| EC402.1-PO4 | 2 | Design of experiments, analysis and interpretation of data is required to understand the concepts of mesophysics and nanostructures |
| EC402.1-PO5 | 1 | Modern engineering tools are required to understand the concepts of mesophysics and nanostructures |
| EC402.1-PO12 | 1 | Concepts of mesophysics and nanostructures can cause technological change |
| EC402.2-PO1 | 2 | Methods for fabrication involves applying the knowledge of mathematics, science and engineering fundamentals to find solutions to complex engineering problems |
| EC402.2-PO2 | 3 | Methods for fabrication of nanolayers and nanoparticles uses first principles of mathematics, natural sciences and engineering sciences |
| EC402.2-PO4 | 2 | Methods for fabrication of nanolayers and nanoparticles includes analysis and interpretation of data |
| EC402.2-PO5 | 1 | Methods for fabrication of nanolayers and nanoparticles uses moder engineering and IT tools |
| EC402.2-PO6 | 1 | Methods for fabrication of nanolayers and nanoparticles should be done in a safe and healthy environment |
| EC402.2-PO12 | 1 | Methods for fabrication of nanoparticles can cause technological change |
| EC402.3-PO1 | 3 | Characterization and analysis of nanomaterials is a complex engineering problem which applies the knowledge of mathematics, science |
| EC402.3-PO2 | 2 | Tools used for characterisation and analysis of Nano materials is a complex engineering problem which is concluded using first principles of mathematics, natural sciences and engineering sciences |
| EC402.3-PO4 | 2 | Characterization and analysis of Nano materials is basically an investigation of complex problems |
| EC402.3-PO5 | 3 | Tools used for characterisation and analysis of Nano materials is done with the help of modern engineering tools |

| | | |
|---|---|---|
| EC402.3-PO6 | 1 | Health, safety and legal consequences of the tools has to be dealt with |
| EC402.3-PO12 | 1 | Tools used for characterisation and analysis of Nano materials can help in causing a technological change |
| EC402.4-PO1 | 3 | Concepts of 2D behavior and supper lattice requires knowledge of mathematics, science |
| EC402.4-PO2 | 2 | 2D behaviour and super lattice uses first principles of mathematics, natural sciences and engineering sciences |
| EC402.4-PO4 | 3 | 2D behaviour and super lattice helps in analysis and interpretation of nanoelectronic devices |
| EC402.4-PO12 | 1 | 2D behaviour and super lattice causes forms the basic concepts that can cause a technological change |
| EC402.5-PO1 | 3 | Charge transport in nanostructures involves applying the knowledge of mathematics, science and engineering fundamentals to find solutions to complex engineering problems |
| EC402.5-PO2 | 2 | Charge transport & quantum transport in nanostructures uses first principles of mathematics, natural sciences and engineering sciences |
| EC402.5-PO4 | 3 | Charge transport & quantum transport in nanostructures helps in analysis and interpretation of nanoelectronic devices |
| EC402.5-PO12 | 1 | Charge transport & quantum transport in nanostructures causes forms the basic concepts that can cause a technological change |
| EC402.6-PO1 | 2 | Nanoelectronic devices involves applying the knowledge of mathematics, science, engineering fundamentals and ECE |
| EC402.6-PO2 | 1 | Nanoelectronic devices are based on principles of mathematics, natural sciences and engineering sciences |
| EC402.6-PO3 | 2 | Nanoelectronic devices should be made with the consideration of public health & safety, and environmental considerations |
| EC402.6-PO4 | 2 | Nanoelectronic devices are analysed and interpreted to provide valid conclusions |
| EC402.-PO5 | 1 | Analysis of nanoelectronic devices are done using modern engineering tools |
| EC402.6-PO7 | 1 | Nanoelectronic devices should be designed for sustainable development |
| EC402.6-PO12 | 1 | Nanoelectronic devices are expected to change technological world in near future. |

**JUSTIFICATION FOR CO-PSO MAPPING**

| MAPPING | LEVEL | JUSTIFICATION |
|---|---|---|

| | | |
|---|---|---|
| EC402.1-PSO1 | 2 | Concepts of mesophysics and nanostructures can be used for VLSI applications |
| EC402.1-PSO2 | 1 | In mesophysics EDA tools can be used for doing experiments |
| EC402.2-PSO1 | 2 | Methods used for fabrication can be applied in VLSI |
| EC402.2-PSO2 | 1 | Fabrication of nanolayers and nanoparticles involves the usage of EDA tools |
| EC402.3-PSO1 | 1 | Characterization and analysis of nanomaterials involves the usage of signal processing fundamentals |
| EC402.3-PSO2 | 1 | Characterization and analysis of nanomaterials involves the usage of EDA tools |
| EC402.4-PSO3 | 2 | Concept of 2D behavior and supper lattice is the basic concept in creating future electronics products |
| EC402.5-PSO3 | 2 | Charge transport in nanostructures is the basic concept used in future nano electronic devices. |
| EC402.6-PSO1 | 3 | Different nanoelectronic devices can be used in signal processing communication and VLSI & ES applications |
| EC402.6-PSO2 | 1 | Experiments using nanoelectronic devices requires EDA tools |
| EC402.6-PSO3 | 1 | Nanoelectronic devices has to be used in future electronic products considering environment protection and sustainability. |

**GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:**

| SNO | DESCRIPTION | PROPOSED ACTIONS | PO MAPPING |
|---|---|---|---|
| 1 | VLSI second order effects – Limitations of microelectronics | Class Seminars/Assignments | 1,2,3,4 |

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURE/NPTEL ETC

**TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:**

| S No: | DESCRIPTION | PO MAPPING |
|---|---|---|
| 1 | . Nanoimprinting and nanopolishing | 1, 2, 3, 4 |

**DESIGN AND ANALYSIS TOPICS:**

| Sl. No. | DESCRIPTION | PO MAPPING |
|---|---|---|
| 1 | DOS plotting | 1,2,3,4,9,12 |

**WEB SOURCE REFERENCES:**

| | |
|---|---|
| 1 | http://www.nptelvideos.in/2012/11/particle-characterization.html |
| | https://www.coursera.org/learn/nanotechnology |

**DELIVERY/INSTRUCTIONAL METHODOLOGIES:**

| | | | |
|---|---|---|---|
| ☐ CHALK & TALK✓ | ☐ STUD. ASSIGNMENT✓ | ☐ WEB RESOURCES✓ | ☐ LCD/SMART BOARDS |
| ☐ STUD. SEMINARS✓ | ☐ ADD-ON COURSES | ☐ GOOGLE CLASSROOM✓ | ☐ VIDEO RECORDINGS✓ |

**ASSESSMENT METHODOLOGIES-DIRECT**

| | | | |
|---|---|---|---|
| ☑ ASSIGNMENTS | ☑ STUD. SEMINARS | ☑ TESTS/MODEL EXAMS | ☐ UNIV. EXAMINATION |
| ☐STUD. LAB PRACTICES | ☐ STUD. VIVA | ☐ MINI/MAJOR PROJECTS | ☐ CERTIFICATIONS |
| ☐ ADD-ON COURSES | ☐ OTHERS | | |

**ASSESSMENT METHODOLOGIES-INDIRECT**

| | |
|---|---|
| ☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE) | ☑ STUDENT FEEDBACK ON FACULTY (TWICE) |
| ☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS | ☐ OTHERS |

**Prepared by** **Approved by**

**Dr. Simi Z S**
**Mr. Kiran K A**
**Mr. Bonifus P L** **Dr. Rithu James**
**(Faculty members in Charge)** **(HoD)**

# COURSE PLAN

| No | Topic | No. of Lectures |
|---|---|---|
| 1 | Introduction to nanotechnology, Impacts, Limitations of conventional microelectronics, Trends in microelectronics and optoelectronics<br><br>Mesoscopic physics, trends in microelectronics and optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence<br><br>Classification of Nano structures, Low dimensional structures Quantum wells, wires and dots, Density of states and dimensionality<br><br>Basic properties of two dimensional semiconductor nanostructures, square quantum wells of finite depth, parabolic and triangular quantum wells<br><br>Quantum wires and quantum dots, carbon nano tube, graphene | 7 |
| 2 | Introduction to methods of fabrication of nano-layers, different approaches, physical vapour deposition, chemical vapour deposition Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide- dry and wet oxidation methods.<br>Fabrication of nano particle- grinding with iron balls, laser ablation, reduction methods, sol gel, self assembly, precipitation of quantum dots. | 6 |
| 3 | Introduction to characterization of nanostructures, tools used for of nano materials characterization, microscope-optical, electron, and electron microscope.<br>Principle of operation of Scanning Tunnelling Microscope, Atomic Force Microscope, Scanning Electron microscope, Specimen interaction. Transmission Electron Microscope<br>X-Ray Diffraction analysis, PL & UV Spectroscopy, Particle size analyser. | 6 |
| 4 | Two dimensional electronic system, two dimensional behaviour, MOSFET structures, Heterojunctions<br>Quantum wells, modulation doped quantum wells, multiple quantum wells<br>The concept of super lattices Kronig - Penney model of super lattice. | 6 |
| 5 | Transport of charge in Nanostructures under Electric field - parallel transport, hot electrons, perpendicular transport.<br>Quantum transport in nanostructures, Coulomb blockade<br>Transport of charge in magnetic field - Effect of magnetic field on a crystal. Aharonov-Bohm effect, the Shubnikov-de Hass effect, the quantum Hall effect | 7 |

| | | |
|---|---|---|
| 6 | Nanoelectonic devices- MODFETS, heterojunction bipolar transistors<br>Resonant tunnel effect, RTD, RTT, Hot electron transistors<br>Coulomb blockade effect and single electron transistor, CNT transistors<br>Heterostructure semiconductor laser<br>Quantum well laser, quantum dot LED, quantum dot laser<br>Quantum well optical modulator, quantum well sub band photo detectors, principle of NEMS. | 10 |
| 5.2 | Amplifiers – Block diagram of Public Address system. Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing. | 4 |
| 5.3 | Electronic Instrumentation – Block diagram of an electronic instrumentation system. | 2 |
| **6** | **Introduction to Communication Systems (7 hours)** | |
| 6.1 | Evolution of communication systems – Telegraphy to 5G. | 1 |
| 6.2 | Radio communication – Principle of AM & FM, frequency bands used for various communication systems, block diagram of superheterodyne receiver. | 4 |
| 6.3 | Mobile communication – Basic principles of cellular communications, principle and block diagram of GSM. | 2 |

# SAMPLE QUESTION

## Module I

1. Mention the impact of nanotechnology on electronics
2. List out what are the limitations of conventional microelectronics?
3. Explain the different characteristic lengths in mesoscopic systems.
4. Write notes on any four characteristic lengths in mesoscopicsystems?
5. What is meant by quantum mechanical coherence? Explain.
6. Classification of Nano structures
7. Explain the classification of nanostructures according to the dimensionality.
8. Differentiate between quantum well and quantum dot?
9. Density of States and Dimensionality
10. What is meant by density of states function? How it differs for 0D, 1D and 2D systems?
11. Starting from Schrodinger equation, show that the density of states in a 2D nano material is independent of energy.
12. Starting from Schrodinger equation, show that the density of states in a 1D semiconductor material is directly proportional to $1/\sqrt{E}$
13. How the density of states function varies with dimensionality?
14. Draw the density of states for a 1D and 0D electron system and explain?
15. Basic Properties of Two Dimensional Semiconductor Nanostructures
16. What is quantum well? Explain the density of states in a quantum well?
17. With suitable equations explain a square quantum well.
18. Show the energy level diagrams and wavefunctions in a finite quantum well.
19. Describe parabolic quantum well.
20. Differentiate between parabolic and triangular quantum well. Explain the features?
21. (Compare and contrast parabolic potential well and triangular potential well) 6)
22. Show the energy level diagram and wavefunctions of triangular quantum well.
23. Quantum Wires and Quantum Dots
24. Write short notes on a) quantum dot b) quantum wire
25. How a quantum wire is different from a quantum dot. Explain?
26. What are the possible energy levels in a quantum wire?
27. What is quantum dot? Give the energy equations?
28. What is quantum dot? Write down the expression for the ground state energy of spherical quantum well.

## Module-II

1. Explain the different types of PVD techniques.
2. Explain the process of PVD.
3. Explain any two physical vapour deposition process?
4. What are the differences between evaporation and sputtering?
5. Compare DC and RF sputtering.
6. Brief up laser ablation method for nano material deposition with significance on RHEED screen.
7. Briefly explain the concept of Laser Ablation.

## Module-III :

1. Compare electron and optical microscope.
2. What is an optical microscope? How it is different from the electron microscope? 3)
3. Why electron microscopes show higher resolution compared to the optical microscopes?
4. What is the basic principle behind scanning probe microscopy?
5. Compare AFM and STM.
6. With a schematic diagram, describe the principle of scanning tunneling microscope?
7. (Explain the principle of operation of STM)
8. What is the basic principle behind STM? What are the different modes of operation?
9. Explain the working principle of Atomic Force Microscope.
10. 6) List the benefits of using carbon nanotubes for AFM tips?

**Module-IV**

1. Explain the concept of modulation doping (What is meant by modulation doping?)
2. Explain modulation doping and why mobility of carrier increases in modulation doped
3. structure.
4. What are the important characteristics of heterostructures?
5. Explain how conductivity is increased in 2D electron gas in AlGaAs-GaAs structure.
6. Compare MQW with superlattice structure.
7. (Differentiate between a MQW and superlattice)
8. Explain Multiple Quantum Wells and its different types with neat diagrams.
9. What are the two different types of MQW?
10. What is a superlattice?

**Module-V**

1. Explain perpendicular transport in quantum structure. (What is perpendicular transport?
2. What is Bloch oscillation? Give an expression for the period of Bloch oscillation.
3. Explain quantum transport in nanostructure and give Landauer Formula.
4. Define quantized conductance.
5. Derive Landauer Formula and explain its significance (State & explain Landauer formula) Coulomb Blockade

**Module-VI**

1. With the help of neat schematic diagram explain MODFETs.
2. (Write a short note on MODFETs)
3. List the advantages of heterojunction quantum wells in MODFETs?
4. 3MODFETs are known as high electron mobility transistor (HEMT). Justify with the help of energy band diagram.
5. Draw the structure of HEMT. Give its features.
6. Explain Resonant Tunnel Effect and the operation of Resonant Tunnel Diodes.
7. Illustrate the principle of operation of Resonant tunnelling diode.
8. With relevant diagrams, explain the IV characteristics of resonant tunnel diode.
9. What is resonant tunnelling? (Explain resonant tunnel effect)

# EC 404

# ADVANCED COMMUNICATION SYSTEM

# COURSE INFORMATION SHEET

| | |
|---|---|
| PROGRAMME: **ELECTRONICS AND COMMUNICATION ENGINEERING** | DEGREE: **B. TECH**<br>UNIVERSITY: **APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY** |
| COURSE: ADVANCED COMMUNICATION SYSTEMS | SEMESTER: **S8** CREDITS: 3 |
| COURSE CODE:<br>EC404 REGULATION: **2015** | COURSE TYPE: **CORE** |
| COURSE AREA/DOMAIN: COMMUNICATION | CONTACT HOURS: 3 **(L) hours/week** |
| CORRESPONDING LAB COURSE CODE (IF ANY): EC431 | LAB COURSE NAME:<br>COMMUNICATION SYSTEMS LAB [OPTICAL & MICROWAVE] |

**SYLLABUS:**

| UNIT | DETAILS | HOURS |
|---|---|---|
| I.1 | Microwave Radio Communications : Introduction, Advantages and Disadvantages, Analog vs digital microwave, frequency vs amplitude modulation | 1 |
| I.2 | Frequency modulated microwave radio system, FM microwave radio repeaters | 1 |
| I.3 | Diversity, protection switching arrangements, FM microwave radio stations, microwave repeater station, line of sight path characteristics | 2 |
| II.1 | Digital TV: Digitized Video, Source coding of Digitized Video, Compression of Frames, DCT based (JPED), Compression of Moving Pictures (MPEG). Basic blocks of MPEG2 and MPE4,Digital Video Broadcasting (DVB) | 4 |
| II.2 | Modulation: QAM (DVB-S, DVB-C), OFDM for Terrestrial Digital TV (DVB –T). Reception of Digital TV Signals (Cable, Satellite and terrestrial). Digital TV over IP, Digital terrestrial TV for mobile | 4 |
| II.3 | Display Technologies: basic working of Plasma, LCD and LED Displays | 2 |
| III.1 | Satellite Communication systems, introduction, Kepler's laws, orbits, orbital effects, orbital perturbations | 2 |
| III.2 | Satellite sub systems, Antennas, Transponders, earth station technology, Link calculation | 2 |
| III.3 | Satellite systems- GEO systems, non-GEO communication systems, Satellite Applications- Global Positioning System, Very Small Aperture Terminal system, Direct to Home Satellite Systems | 3 |
| IV.1 | Evolution of mobile radio communications, paging systems, Cordless telephone systems, comparison of various wireless systems | 2 |
| IV.2 | Introduction to Modern Wireless Communication Systems, Second generation cellular networks, third generation wireless networks, fourth generation wireless technologies | 1 |
| IV.3 | Wireless in local loop, wireless local area networks, Blue tooth and Personal Area networks, Over view of WIMAX Technologies, architecture, spectrum allocation | 2 |
| V.1 | Cellular concept, hand off strategies, Interference and system capacity: Cell splitting, Sectoring, Repeaters, and Microcells.<br>Cellular System Design Fundamentals: Frequency Reuse, channel assignment strategies, handoff Strategies, Interference and system capacity, tracking and grade off service, improving coverage and capacity | 3 |

| | | |
|---|---|---|
| V.2 | Wireless propagation mechanism, free space propagation model, ground reflection model, knife edge diffraction model, path loss prediction in hilly terrain, introduction to fading and diversity techniques, Introduction to MIMO system | 3 |
| VI.1 | Introduction to Multiple Access, FDMA, TDMA, Spread Spectrum multiple Access, space division multiple access, CDMA, OFDM | 2 |
| VI.2 | Wireless Networking, Difference between wireless and fixed telephone networks, development of wireless networks, fixed network transmission hierarchy, traffic routing in wireless networks, wireless data services, Wireless standards, | 2 |
| VI.3 | GSM system architecture, radio link aspects, network aspects | 1 |
| VI.4 | Introduction to new data services like High Speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), Digital Enhanced Cordless Telecommunications (DECT) , Enhanced Data Rate for Global Evolution (EDGE), Ultra wideband systems (UWB), Push To Talk (PTT) technology, Mobile IP | 5 |
| **TOTAL HOURS** | | **24** |

**TEXT/REFERENCE BOOKS:**

| T/R | BOOK TITLE/AUTHORS/PUBLICATION |
|---|---|
| T1 | Herve Benoit, Digital Television Satellite, Cable, Terrestrial, IPTV, Mobile TV in the DVB Framework, 3/e, Focal Press, Elsevier, 2008 |
| T2 | Dennis Roody, Satellite communication, 4/e, McGraw Hill, 2006. |
| T3 | Theodore S. Rappaport: Wireless communication principles and practice,2/e, Pearson Education, 1990 |
| T4 | Simon Haykin, Michael Mohar, Modern wireless communication, Pearson Education,2008 |
| R1 | Jochen Schiller, Mobile Communications, Pearson, 2008. |
| R2 | Mishra, Wireless communications and Networks, McGraw Hill, 2/e, 2013. |
| R3 | Nathan, Wireless communications, PHI, 2012. |
| R4 | Singal, Wireless communications, Mc Graw Hill, 2010. |
| R5 | Tomasi, Advanced Electronic Communication Systems, 6/e, Pearson, 2015. |
| R6 | W.C.Y.Lee, Mobile Cellular Telecommunication, McGraw Hill, 2010. |

**COURSE PRE-REQUISITES:**

| C.CODE | COURSE NAME | DESCRIPTION | SEM |
|---|---|---|---|
| EC208 | Analog Communication Engineering | Basics of Analog Communication | IV |
| EC302 | EC302 Digital Communication | Basics of Digital Communication | VI |
| EC403 | Microwave & Radar Engineering | Basics of MW devices and Radar systems | VII |

**COURSE OBJECTIVES:**

| | |
|---|---|
| 1 | To introduce the students to the basic principles of mechanical engineering |

**COURSE OUTCOMES:**

| SL. NO. | DESCRIPTION | Blooms' Taxonomy Level |
|---|---|---|

| | | |
|---|---|---|
| C0.1 | Students will be able to ***understand*** the important concepts of Microwave Radio Communication system and will be able to **analyze** diversity and protection switching systems | Understand and Analyze (level 2, 4) |
| C0.2 | Students will be able to ***Illustrate*** the working and features of Digital TV and can ***identify*** the scope of digital TV over IP | Understand (level 2) |
| C0.3 | Students will be able to ***identify*** the different components of a Satellite Communication System and ***differentiate*** among various Satellite Applications- Global Positioning System, Very Small Aperture Terminal system, Direct to Home Satellite Systems. | Understand (level 2) |
| C0.4 | Students will be able to ***understand*** the evolution of mobile radio communication system and working of WIMAX, Bluetooth etc. | Understand (level 2) |
| C0.5 | Students will be able to ***understand*** the design of cellular system fundamentals and will be able to **select** appropriate transmission path model for a specific terrain requirement. | Apply (level 3) |
| C0.6 | Students will be able to ***understand*** wireless networking techniques and rate various data services like HSCSD, GPRS, DECT etc. | Understand and evaluate (level 2,5) |

## CO-PO AND CO-PSO MAPPING

| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** | **PSO 3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 3 | 3 | 2 | | | | | | | | | 3 | 2 | |
| CO 2 | 2 | 3 | 2 | 3 | | | | | | | | | 2 | 1 | |
| CO 3 | 3 | 3 | 3 | 2 | | | | | 1 | | | | 3 | 3 | |
| CO 4 | 2 | 3 | 3 | 3 | | | | | 1 | | | | 3 | 3 | |
| CO 5 | 2 | 3 | 3 | 2 | | | | | | 2 | | | 3 | 2 | 2 |
| CO 6 | 3 | 3 | 3 | | | | | | | 2 | | 2 | 2 | 1 | 2 |

## JUSTIFATIONS FOR CO-PO MAPPING

| MAPPING | LOW/MEDIUM/HIGH | JUSTIFICATION |
|---|---|---|
| CO1-PO1 | H | Line of sight path loss calculation |
| CO1-PO2 | H | Diversity |
| CO1-PO3 | H | Design of FM MW radio transmitter and receiver |
| CO1-PO4 | M | Protection switching arrangements |
| CO1-PSO1 | H | MW Repeater station |
| CO1-PSO2 | M | FM mw Radio system |
| CO2-PO1 | M | DCT based Compression |

| | | |
|---|---|---|
| CO2-PO2 | H | Modulation:DVB-S ,DVB-C |
| CO2-PO3 | M | JPEG,MPEG Coding |
| CO2-PO4 | H | OFDM for DVB-T |
| CO2-PSO1 | M | Design and implementation of DVB-S,DVB-C,DVB-T Receiver |
| CO2-PSO2 | L | Source coding and channel coding of video signals |
| CO3-PO1 | H | Satellite link calculation |
| CO3-PO2 | H | Analysis of Satellite sub systems |
| CO3-PO3 | H | Design of antennain satellitecommn system |
| CO3-PO4 | M | Analysis of GEO And Non-GEO Communication systems |
| CO3-PO9 | L | Individual and group assignments in various satellite applications |
| CO3-PSO1 | H | Design and implementation of satellite communication systems |
| CO3-PSO2 | H | Orbits, Orbital effects, Orbital perturbations |
| CO4-PO1 | M | Mobile radio communication |
| CO4-PO2 | H | Identify and compare various wireless systems |
| CO4-PO3 | H | Introduction to modern wireless communication system |
| CO4-PO4 | H | Analysis of Spectrum allocation |
| CO4-PO9 | L | Individual and group assignments |
| CO4-PSO1 | H | Design and implementation of wireless local area networks |
| CO4-PSO2 | H | Overview of WIMAX Technologies |
| CO5-PO1 | M | Channel Allocation, wireless propagation models |
| CO5-PO2 | H | Traffic Intensity |
| CO5-PO3 | H | Overview of Design of cellular system |
| CO5-PO4 | M | Handoff strategies |
| CO5-PO10 | M | Seminar |
| CO5-PSO1 | H | Cellular design fundamentals |
| CO5-PSO2 | M | Introduction to MIMO system |
| CO6-PO1 | H | Multiple Access Techniques |
| CO6-PO2 | H | Traffic routing in wireless networks |
| CO6-PO3 | H | Multiple access design |
| CO6-PO10 | M | Seminar |
| CO6-PSO1 | M | Review and analysis of CDMA system |
| CO6-PSO2 | L | GSM System Architecture |
| CO6-PSO3 | M | Assignment, Seminar and Study of system |

**GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:**

| SL NO | DESCRIPTION | PROPOSED ACTIONS | RELEVANCE WITH POs | RELEVANCE WITH PSOs |
|---|---|---|---|---|
| 1 | Monochrome TV Basics | ASSIGNMENT | 1 | - |

| | | | | |
|---|---|---|---|---|
| 2 | DVI and HDMI links for interconnecting digital audiovisual equipment | ASSIGNMENT | 1 | |
| 3 | Discrete Cosine Transform | TUTORIAL | 1 | - |

**TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:**

| SL NO | DESCRIPTION | PROPOSED ACTIONS | RELEVANCE WITH POs | RELEVANCE WITH PSOs |
|---|---|---|---|---|
| 1 | Introduction to 5G | Lectures | 1 | - |
| 2 | Introduction to massive MIMO | Lectures | 1 | - |
| 3 | High Definition Television (HDTV) | Video lectures | 1 | - |
| 4 | Spectrum Allocation in Cognitive Radio | Lectures | 1 | - |

**WEB SOURCE REFERENCES:**

| | |
|---|---|
| 1 | nptel.iitm.ac.in |
| 2 | ocw.mit.edu |
| 3 | www.**utexas**.edu |

**DELIVERY/INSTRUCTIONAL METHODOLOGIES:**

| | | | |
|---|---|---|---|
| ☐ CHALK & TALK | ☑ STUD. ASSIGNMENTS | ☑ WEB RESOURCES | ☑ ONLINE CLASSES |
| ☑ LCD/SMART BOARDS | ☐ STUD. SEMINARS | ☐ ADD-ON COURSES | |

**ASSESSMENT METHODOLOGIES-DIRECT**

| | | | |
|---|---|---|---|
| ☑ASSIGNMENTS | ☐ STUD. SEMINARS | ☑ TESTS/MODEL EXAMS | ☑ UNIV. EXAMINATION |
| ☐ STUD. LAB PRACTICES | ☐ STUD. VIVA | ☐ MINI/MAJOR PROJECTS | ☐ CERTIFICATIONS |
| ☐ ADD-ON COURSES | ☐ OTHERS | | |

**ASSESSMENT METHODOLOGIES-INDIRECT**

| | |
|---|---|
| ☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE) | ☑ STUDENT FEEDBACK ON FACULTY (TWICE) |
| ☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS | ☐ OTHERS |

**Prepared by** **Approved by**

Swapna Davies, Shyama Sreekumar Dr. Rithu James

# COURSE PLAN

| UNIT | DETAILS | HOURS |
|---|---|---|
| I.1 | Microwave Radio Communications : Introduction, Advantages and Disadvantages, Analog vs digital microwave, frequency vs amplitude modulation | 1 |
| I.2 | Frequency modulated microwave radio system, FM microwave radio repeaters | 1 |
| I.3 | Diversity, protection switching arrangements, FM microwave radio stations, microwave repeater station, line of sight path characteristics | 2 |
| II.1 | Digital TV: Digitized Video, Source coding of Digitized Video, Compression of Frames, DCT based (JPED), Compression of Moving Pictures (MPEG). Basic blocks of MPEG2 and MPE4,Digital Video Broadcasting (DVB) | 4 |
| II.2 | Modulation: QAM (DVB-S, DVB-C), OFDM for Terrestrial Digital TV (DVB –T). Reception of Digital TV Signals (Cable, Satellite and terrestrial). Digital TV over IP, Digital terrestrial TV for mobile | 4 |
| II.3 | Display Technologies: basic working of Plasma, LCD and LED Displays | 2 |
| III.1 | Satellite Communication systems, introduction, Kepler's laws, orbits, orbital effects, orbital perturbations | 2 |
| III.2 | Satellite sub systems, Antennas, Transponders, earth station technology, Link calculation | 2 |
| III.3 | Satellite systems- GEO systems, non-GEO communication systems, Satellite Applications- Global Positioning System, Very Small Aperture Terminal system, Direct to Home Satellite Systems | 3 |
| IV.1 | Evolution of mobile radio communications, paging systems, Cordless telephone systems, comparison of various wireless systems | 2 |
| IV.2 | Introduction to Modern Wireless Communication Systems, Second generation cellular networks, third generation wireless networks, fourth generation wireless technologies | 1 |
| IV.3 | Wireless in local loop, wireless local area networks, Blue tooth and Personal Area networks, Over view of WIMAX Technologies, architecture, spectrum allocation | 2 |
| V.1 | Cellular concept, hand off strategies, Interference and system capacity: Cell splitting, Sectoring, Repeaters, and Microcells.<br>Cellular System Design Fundamentals: Frequency Reuse, channel assignment strategies, handoff Strategies, Interference and system capacity, tracking and grade off service, improving coverage and capacity | 3 |
| V.2 | Wireless propagation mechanism, free space propagation model, ground reflection model, knife edge diffraction model, path loss prediction in hilly terrain, introduction to fading and diversity techniques, Introduction to MIMO system | 3 |
| VI.1 | Introduction to Multiple Access, FDMA, TDMA, Spread Spectrum multiple Access, space division multiple access, CDMA, OFDM | 2 |
| VI.2 | Wireless Networking, Difference between wireless and fixed telephone networks, development of wireless networks, fixed network transmission hierarchy, traffic routing in wireless networks, wireless data services, Wireless standards, | 2 |
| VI.3 | GSM system architecture, radio link aspects, network aspects | 1 |
| VI.4 | Introduction to new data services like High Speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), Digital Enhanced Cordless Telecommunications (DECT) , Enhanced Data Rate for Global Evolution (EDGE), Ultra wideband systems (UWB), Push To Talk (PTT) technology, Mobile IP | 5 |

# SAMPLE QUESTION

## Module 1

1. With a block schematic explain microwave radio IF repeater station.

2. Explain hot standby protection switching arrangement of a microwave radio system.

3. How the diversity is enhancing the performance of radio wave propagation?

4. Illustrate with figure a "Microwave radio communications link". List the advantages and disadvantages of Microwave Radio Communication.

5. Explain the need for a microwave repeater. Describe a baseband repeater with suitable diagram.

6. Explain the following with diagram (i) Space Diversity (ii) Frequency Diversity.

## Module 2

1. With a block diagram explain the DVB-T system.

2. How the images compressed with the help of Discrete Cosine Transform (DCT)? Explain.

3. Compare LED and LCD display systems.

4. Differentiate entropy coding with transform coding.

5. What are Group of Pictures? Discuss the features of each.

6. With a block diagram explain MPEG2 system.

## Module 3

1. Explain the effect of Non-spherical shape of earth on a satellite orbit.

2. With the help of a block diagram briefly explain Satellite Transponder Subsystem.

3. A satellite TV signal occupies the full transponder bandwidth of 36 MHz and it must provide a C/N ratio at the destination earth station of 22 dB. Given that the total transmission loss is 210 dB and the destination earth station G/T ratio is 31 dB/K. Calculate the satellite EIRP required. Given value k in dB is - 228.6 dB.

4. Briefly describe about global positioning satellite system.

5. Derive the expression of orbital velocity for the circular orbit.

6. Summarize Kepler's laws.

**Module 4**

1. With the help of figure, describe WLL technology and its advantages

2. What are the different versions of WLAN?

3. Compare 1G, 2G, 3G & 4G systems.

4. Mention the features of Bluetooth.

5. State the differences between TDD & FDD in cellular communications.

6. List out the features of UMTS.

**Module 5**

1, What is meant by small-scale fading? List out the factors influencing small-scale fading.

2. With necessary diagrams explain the technique 'Hand off '. Describe the different Hand off strategies

3. Describe knife edge diffraction model.

4. Write a short note on MIMO systems

5. Explain how the frequency reuse concept is significant in cellular system.

6. Derive the expression for path loss of Two Ray Ground Reflection model

**Module 6**

1. Explain in detail about the characteristics and network architecture of GPRS.

2. Give the concepts of Push To Talk (PTT) technology

3. Explain the OFDM implementation of multicarrier modulation with necessary diagrams.

4. Describe the traffic routing in wireless networks.

5. Explain Digital Enhanced Cordless Telecommunications (DECT) data service.

6. Discuss in detail about GSM system architecture.

# EC 468

# SECURE COMMUNICATION

# COURSE INFORMATION SHEET

| | |
|---|---|
| PROGRAMME: **ELECTRONICS AND COMMUNICATION ENGINEERING** | DEGREE: **B. TECH**<br>UNIVERSITY: **APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY** |
| COURSE: **SECURE COMMUNICATION** | SEMESTER: **S8** CREDITS: **3** |
| COURSE CODE: **EC468** REGULATION: **2016** | COURSE TYPE: **ELECTIVE** |
| COURSE AREA/DOMAIN: **COMMUNICATION** | CONTACT HOURS: **3 (L) hours/week** |
| CORRESPONDING LAB COURSE CODE (IF ANY): NIL | LAB COURSE NAME: |

**SYLLABUS:**

| UNIT | DETAILS | HOURS |
|---|---|---|
| I.1 | Introduction on security, security goals and types of attacks: Passive attack, active attack, attacks on confidentiality, attacks on integrity and availability, Security services and mechanisms. | 5 |
| II.1 | Modular arithmetic: Groups, Ring, Fields. The Euclidean algorithm, Finite fields of the form GF(p) | 4 |
| II.2 | Polynomial arithmetic: Finite fields of the form GF (2n). | 4 |
| III.1 | Symmetric Ciphers, Symmetric Cipher Model | 3 |
| III.2 | Substitution Techniques, Caesar Cipher, Mono alphabetic Cipher, Play fair cipher, Hill cipher, Poly alphabetic Cipher, one time pad | 4 |
| IV.1 | Transposition techniques ,Block Ciphers, Data encryption Standards, DES Encryption, DES decryption | 3 |
| IV.2 | Differential and Linear Crypt analysis Advanced Encryption standard | 2 |
| IV.3 | The AES Cipher, substitute bytes transformation, Shift row transformation, Mix Column transformation. | 2 |
| V.1 | Public key cryptosystem, Application for Public key cryptosystem requirements | 2 |
| V.2 | RSA algorithm, Key management, Distribution of public key, public key certificates, Distribution of secret keys. | 5 |
| VI.1 | Intruders: Intrusion techniques, Intrusion detection, Statistical anomaly detection, Rule based intrusion detection, Distributed intrusion detection, Honey pot, Intrusion detection exchange format. | 5 |
| VI.2 | Password management: Password protection, password selection strategies. | 2 |
| **TOTAL HOURS** | | **41** |

**TEXT/REFERENCE BOOKS:**

| T/R | BOOK TITLE/AUTHORS/PUBLICATION |
|---|---|
| T1 | Behrouz A. Forouzan , Cryptography and Network security Tata McGraw-Hill, 2008 |
| T2 | William Stallings, Cryptography and Network security: principles and practice", 2nd Edition, Prentice Hall of India, New Delhi, 2002 |

| | |
|---|---|
| R1 | David S. Dummit & Richard M Foote, Abstract Algebra, 2nd Edition, Wiley India Pvt. Ltd., 2008. |
| R2 | Douglas A. Stinson, Cryptography, Theory and Practice, 2/e, Chapman & Hall, CRC Press Company, Washington, 2005. |
| R3 | Lawrence C. Washington, Elliptic Curves: Theory and Cryptography, Chapman & Hall, CRC Press Company, Washington, 2008. |
| R4 | N. Koeblitz: A course in Number theory and Cryptography, 2008 |
| R5 | Thomas Koshy: Elementary Number Theory with Applications, 2/e, Academic Press, 2007 |
| R6 | Tyagi and Yadav , Cryptography and network security, Dhanpatrai, 2012 |

**COURSE PRE-REQUISITES:**

| C.CODE | COURSE NAME | DESCRIPTION | SEM |
|---|---|---|---|
| - | NIL | | |

**COURSE OBJECTIVES:**

| | |
|---|---|
| 1 | To impart the students about the theory and technology behind the secure communication |

**COURSE OUTCOMES:**

| SL. NO. | DESCRIPTION | Blooms' Taxonomy Level |
|---|---|---|
| C0.1 | The students will have an understanding about security goals, services and mechanisms. | Understand (level 2) |
| C0.2 | The students will have thorough understanding about Algebraic structures and Modular Arithmetic and their application in encryption-decryption process. | Understand & Apply (level 2,3) |
| C0.3 | The student will have good understanding of encryption and cryptanalysis of substitution ciphers. | Understand & Apply (level 2,3) |
| C0.4 | The student will have a detailed understanding of DES and AES encryption standards and their application. | Understand & Apply (level 2,3) |
| C0.5 | The student will have a good understanding about the Public Key Cryptosystem. | Understand (level 2) |
| C0.6 | Students will be able to classify and differentiate different intrusion techniques | Understand (level 2) |

**CO-PO AND CO-PSO MAPPING**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | | | | | | | | | | | | | | |
| CO 2 | 2 | 2 | | | | 1 | | | | | | | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 3 | 2 | 2 | | | | 1 | | | | | | 2 | | | 2 |
| CO 4 | 2 | 2 | | | | 2 | | | | | | 2 | 2 | | 2 |
| CO 5 | 2 | | | | | | | | | 1 | | | | | |
| CO 6 | 2 | | | | | | | | | 1 | | 2 | | | |

## JUSTIFATIONS FOR CO-PO MAPPING

| MAPPING | LOW/MEDIUM/HIGH | JUSTIFICATION |
|---|---|---|
| CO1-PO1 | M | Understanding about security goals, services and mechanisms requires knowledge of science and engineering fundamentals. |
| CO2-PO1 | M | Modular Arithmetic and their application in encryption-decryption process requires knowledge of science, mathematics and engineering fundamentals |
| CO2-PO2 | M | Modular arithmetic is used to check and design fields. |
| CO2-PO6 | L | Fields forms the base for cryptographic applications which are used for secure communication. |
| CO3-PO1 | M | Understanding of encryption and cryptanalysis of substitution ciphers requires knowledge of science, mathematics and engineering fundamentals |
| CO3-PO2 | M | Analyzing different encryption and cryptanalysis of substitution ciphers. |
| CO3-PO6 | L | Symmetric encryption ensures secure communication of data. Cryptography is designed to meet the needs of society in security context. |
| CO3-PO12 | M | Encryption Algorithms should be upgraded by analyzing the current societal issues. |
| CO4-PO1 | M | Requires mathematical basics to construct DES and AES encryption standards and their application |
| CO4-PO2 | M | Analyzing AES, DES and their advanced versions for secure communication |
| CO4-PO6 | M | DES & AES algorithms provide safety by securing the information shared. Cryptography is designed to meet the needs of society in security context. |
| CO4-PO12 | M | Encryption Algorithms should be upgraded by analyzing the current societal issues. |
| CO5-PO1 | M | Understanding about the Public Key Cryptosystem requires knowledge of science and engineering fundamentals. |
| CO5-PO10 | L | Seminars & Group discussions |
| CO6-PO1 | M | Ensuring security for data in all fields of life. Statistical analysis to identify the intrusion types |
| CO6-PO10 | L | Seminars & Group discussions |

| | | |
|---|---|---|
| CO6-PO12 | M | Algorithms should be upgraded by analyzing the current societal issues, Intrusion detection can benefit the society. |

**JUSTIFATIONS FOR CO-PSO MAPPING**

| MAPPING | LOW/MEDIUM/HIGH | JUSTIFICATION |
|---|---|---|
| CO3-PSO3 | M | Development of more advanced encryption algorithms are required to ensure security of data in present scenario. |
| CO4-PSO1 | M | Can design & develop secure systems by incorporating DES & AES. |
| CO4-PSO3 | M | Encryption algorithms need to be upgraded for sustainable developments. Development of more advanced encryption algorithms are required to ensure security of data in present scenario. |

**GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:**

| SL NO | DESCRIPTION | PROPOSED ACTIONS | RELEVANCE WITH POs | RELEVANCE WITH PSOs |
|---|---|---|---|---|
| 1 | Euler totient function | Video Lecture | 1 | - |
| 2 | Simplified AES | Video Lecture | 1 | - |

**TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:**

| SL NO | DESCRIPTION | PROPOSED ACTIONS | RELEVANCE WITH POs | RELEVANCE WITH PSOs |
|---|---|---|---|---|
| 1 | Triple Data Encryption Standard (Triple DES algorithm) | Lectures | 1 | - |
| 2 | Blowfish Algorithm. | Video lectures | 1,2,12 | - |
| 3 | Light Weight Cryptography for IOT Devices. | Video lectures | 1,2,6,12 | 3 |

**WEB SOURCE REFERENCES:**

| | |
|---|---|
| 1 | http://www.cs.auckland.ac.nz/~pgut001/cryptlib/index.html |
| 2 | http://people.csail.mit.edu/rivest/crypto-security.html |
| 3 | http://www.iacr.org/jofc/ |
| 4 | http://www.secrypt.icete.org/ |
| 5 | https://www.iacr.org/events/ |

**DELIVERY/INSTRUCTIONAL METHODOLOGIES:**

| | | | |
|---|---|---|---|
| ☐ CHALK & TALK | ☑ STUD. ASSIGNMENTS | ☑ WEB RESOURCES | ☑ ONLINE CLASSES |
| ☑ LCD/SMART BOARDS | ☑ STUD. SEMINARS | ☐ ADD-ON COURSES | |

**ASSESSMENT METHODOLOGIES-DIRECT**

| | | | |
|---|---|---|---|
| ☑ASSIGNMENTS | ☑ STUD. SEMINARS | ☑ TESTS/MODEL EXAMS | ☑ UNIV. EXAMINATION |
| ☐ STUD. LAB PRACTICES | ☐ STUD. VIVA | ☐ MINI/MAJOR PROJECTS | ☐ CERTIFICATIONS |
| ☐ ADD-ON COURSES | ☐ OTHERS | | |

**ASSESSMENT METHODOLOGIES-INDIRECT**

| | |
|---|---|
| ☑ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE) | ☑ STUDENT FEEDBACK ON FACULTY (TWICE) |
| ☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS | ☐ OTHERS |

**Prepared by** **Approved by**

Ms. Neethu Radha Gopan
Ms. Aarathi Sankar
**DEC)**

Dr. Rithu James
**(HOD,**

**(Faculties in Charge)**

# COURSE PLAN

| UNIT | DETAILS | HOURS |
|---|---|---|
| I.1 | Introduction on security, security goals and types of attacks: Passive attack, active attack, attacks on confidentiality, attacks on integrity and availability, Security services and mechanisms. | 5 |
| II.1 | Modular arithmetic: Groups, Ring, Fields. The Euclidean algorithm, Finite fields of the form GF(p) | 4 |
| II.2 | Polynomial arithmetic: Finite fields of the form GF (2n). | 4 |
| III.1 | Symmetric Ciphers, Symmetric Cipher Model | 3 |
| III.2 | Substitution Techniques, Caesar Cipher, Mono alphabetic Cipher, Play fair cipher, Hill cipher, Poly alphabetic Cipher, one time pad | 4 |
| IV.1 | Transposition techniques ,Block Ciphers, Data encryption Standards, DES Encryption, DES decryption | 3 |
| IV.2 | Differential and Linear Crypt analysis Advanced Encryption standard | 2 |
| IV.3 | The AES Cipher, substitute bytes transformation, Shift row transformation, Mix Column transformation. | 2 |
| V.1 | Public key cryptosystem, Application for Public key cryptosystem requirements | 2 |
| V.2 | RSA algorithm, Key management, Distribution of public key, public key certificates, Distribution of secret keys. | 5 |
| VI.1 | Intruders: Intrusion techniques, Intrusion detection, Statistical anomaly detection, Rule based intrusion detection, Distributed intrusion detection, Honey pot, Intrusion detection exchange format. | 5 |
| VI.2 | Password management: Password protection, password selection strategies. | 2 |
| **TOTAL HOURS** | **41** | |

# SAMPLE QUESTION

## Module 1

**1**. Describe any five security mechanisms.
2. Differentiate between active and passive attacks
3. Explain the security attacks on integrity with examples.
4. Discuss the three security goals.
5. Find a solution for $6x + 1 \equiv 2 \bmod 7$
6. Give different types of attacks in a cryptosystem.
7. Discuss attacks on integrity. How it can be prevented?
8. Discuss attacks on availability.

## Module 2

1. It is told in arithmetic that the remainder of an integer divided by 4 is the same as the remainder of division of the two rightmost digits by 4. Use the properties of mod operator to prove this claim.
2. Differentiate between group, ring, abelian group and field with examples.
3. Define the inverse and identity elements for any operation in a group.

## Module 3

1. Explain symmetric cipher model with mathematical description
2. Discuss the properties of an ideal cryptographic system.
3. Encrypt the plaintext "come to the window" with the keyword "KEYWORD" using playfair cipher technique.
4. Encrypt the plaintext "ACT" with the keyword "GYBNQKURP" using hill cipher encryption technique

## Module 4

1. Differentiate between differential and linear cryptanalysis.
2. Give the basic permutations and substitutions in DES.
3. Explain in detail about the Add round key stage and key expansion of AES encryption standard.
4. Explain the concept of Rotor Machines.
5. Discuss four transformations used in Advanced Encryption Standard.
6. With the help of a block diagram, explain the process of key generation in DES.

## Module 5

1. Explain RSA algorithm with parameters $p = 3$, $q = 11$, $e = 7$ and $M = 5$.
2. Explain Diffie- Hellman public key cryptosystem with an example.
3. What is the difference between symmetric encryption and asymmetric encryption?
4. Using Key analogy, explain Public Key Cryptosystem.
5. Give applications of PKCS.
6. Explain PKDS with PKCS. Give comparison.

## Module 6

1. Give the requirements of a secure password.
2. What are the advantages of Honey pot?
3. How does distributed intrusion detection work?
4. Write note on password protection.
5. Discuss the techniques for intrusion detection.
6. What is a 'salt' ? What is its purpose in password protection?
7. Explain briefly about the four password selection strategies used.
8. Discuss intrusion detection exchange format.

# EC 466

# CYBER SECURITY

# COURSE INFORMATION SHEET

| | |
|---|---|
| **PROGRAMME: ELECTRONICS AND COMMUNICATION ENGINEERING** | **DEGREE: B. TECH**<br><br>**UNIVERSITY: APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY** |
| **COURSE: CYBER SECURITY** | **SEMESTER: S8 CREDITS: 3** |
| **COURSE CODE: EC404 REGULATION: 2015** | **COURSE TYPE: Elective** |
| **COURSE AREA/DOMAIN: COMMUNICATION** | **CONTACT HOURS: 3+0 (L+T) hours/week** |
| **CORRESPONDING LAB COURSE CODE (IF ANY): NIL** | **LAB COURSE NAME:NIL** |

**SYLLABUS:**

| UNIT | DETAILS | HOURS |
|---|---|---|
| **I** | **Introduction to Vulnerability Scanning Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit.** | **7** |
| **II** | **Network Vulnerability Scanning Networks Vulnerability Scanning - Netcat, Socat, understanding Port and Services tools - Datapipe, Fpipe, WinRelay, Network Reconnaissance – Nmap, THC-Amap and System tools, Network Sniffers and Injection tools – Tcpdump and Windump, Wireshark, Ettercap, Hping, Kismet** | **7** |
| **III** | **Network Defense tools Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection** | **8** |
| **IV** | **Web Application Tools Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap. DVWA, Webgoat, Password Cracking and Brute-Force Tools – John the Ripper, L0htcrack, Pwdump, HTCHydra** | **6** |
| **V** | **Introduction to Cyber Crime and law Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world, A Brief History of the Internet, Recognizing and Defining Computer Crime,** | **8** |

| | | |
|---|---|---|
| | **Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000.** | |
| **VI** | **Introduction to Cyber Crime Investigation Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks** | **6** |
| **TOTAL HOURS** | | **24** |

**TEXT/REFERENCE BOOKS:**

| **T/R** | **BOOK TITLE/AUTHORS/PUBLICATION** |
|---|---|
| **T1** | **Mike Shema , Anti-Hacker Tool Kit, Mc Graw Hill** |
| **T2** | **Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley** |
| **R1** | **Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley** |
| **R2** | **Forouzan, Data Communication and Networking(Glogal Edition) 5/e, McGraw Hill Education India, 2013** |
| **R3** | **Forouzan, TCP/IP Protocol Suite 4e, McGraw Hill Education India, 2010** |

**COURSE PRE-REQUISITES:**

| **C.CODE** | **COURSE NAME** | **DESCRIPTION** | **SEM** |
|---|---|---|---|
| **EC407** | **Computer Communication** | **Basic knowledge of computer communication** | **VII** |

**COURSE OBJECTIVES:**

| | |
|---|---|
| **1** | **To familiarize various types of vulnerabilities** |
| **2** | **To study the tools used in vulnerability scanning** |
| **3** | **To familiarize various types of cyber-attacks and cyber-crimes** |
| **4** | **To give an overview of the cyber laws** |
| **5** | **To study the defensive techniques against these attack** |

**COURSE OUTCOMES:**

| SL. NO. | DESCRIPTION | Blooms' Taxonomy Level |
|---|---|---|
| C0.1 | Students will be able to ***understand*** the various types of vulnerabilities and will be able to analyze vulnerabilities | Understand and Analyze (level 2, 4) |
| C0.2 | Students will be able to ***understand*** the tools used in vulnerability scanning and can ***identify*** the vulnerabilities that may occur | Understand (level 2) |
| C0.3 | Students will be able to ***identify*** various types of cyber- attacks and cyber-crimes | Understand (level 2) |
| C0.4 | Students will be able to ***understand*** different cyber laws | Understand (level 2) |
| C0.5 | Students will be able to ***understand*** the defensive techniques and will be able to select appropriate techniques against these attacks | Apply (level 3) |

**CO-PO AND CO-PSO MAPPING**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 3 | 3 | 1 | | | | | 1 | | | 2 | 1 | 2 | 1 |
| CO 2 | 3 | 3 | 3 | 1 | | 1 | | | 1 | | | 1 | 1 | 2 | 1 |
| CO 3 | 3 | 3 | 3 | 1 | | 1 | | | 1 | | | 1 | 2 | 1 | 1 |
| CO 4 | 3 | 3 | 3 | 1 | | | | | 1 | | | 1 | 1 | 1 | 1 |
| CO 5 | 3 | 3 | 3 | 1 | | | | | | | | | | | |

**JUSTIFATIONS FOR CO-PO MAPPING**

| MAPPING | LOW/MEDIUM/HIGH | JUSTIFICATION |
|---|---|---|
| CO1-PO1 | H | Cyber security systems design involves solving complex engineering problems |

| | | |
|---|---|---|
| **CO1-PO2** | **H** | **Principles of mathematics and engineering sciences are used in various aspects of Cyber security systems design** |
| **CO1-PO3** | **H** | **Using the knowledge of Cyber security systems design, we can design and develop solutions for complex engineering problems** |
| **CO1-PO4** | **L** | **Cyber security systems design knowledge can be used to design and conduct experiments to provide valid conclusions** |
| **CO1-PO9** | **L** | **Expertise developed, which will enable the student to become a productive member of a design team** |
| **CO1-PO12** | **M** | **The student will become aware of the need for lifelong learning and the continued upgrading of technical knowledge** |
| **CO2-PO1** | **H** | **Cyber security systems Architecture involves solving complex engineering problems** |
| **CO2-PO2** | **H** | **Principles of mathematics and engineering sciences are used in various aspects of Cyber security systems Architecture** |
| **CO2-PO3** | **H** | **Knowledge of Cyber security systemsarchitecture can be used to design and develop solutions for complex engineering problems** |
| **CO2-PO4** | **L** | **Cyber security systems Architecture knowledge can be used to design and conduct experiments to provide valid conclusions** |
| **CO2-PO6** | **L** | **Knowledge of Cyber security systemsArchitecture will help understand issues and societal problems related to cybercrimes and computer hacking** |
| **CO2-PO9** | **L** | **Expertise developed, which will enable the student to become a productive member of a design team** |
| **CO2-PO12** | **L** | **The student will become aware of the need for lifelong learning and the continued upgrading of technical knowledge** |
| **CO3-PO1** | **H** | **Cyber security systemsdesign involves solving complex engineering problems** |
| **CO3-PO2** | **H** | **Principles of mathematics and engineering sciences are used in various aspects of processor** |
| **CO3-PO3** | **H** | **Knowledge of Cyber security systemsarchitecture can be used to design and develop solutions for complex engineering problems** |

| | | |
|---|---|---|
| **CO3-PO4** | **L** | **Cyber security systems Architecture knowledge can be used to design and conduct experiments to provide valid conclusions** |
| **CO3-PO6** | **L** | **Knowledge of Cyber security systemsArchitecture will help understand issues and societal problems related to cybercrimes and computer hacking** |
| **CO3-PO9** | **L** | **Expertise developed, which will enable the student to become a productive member of a design team** |
| **CO3-PO12** | **L** | **The student will become aware of the need for lifelong learning and the continued upgrading of technical knowledge** |
| **CO4-PO1** | **H** | **Cyber security systemsdesign involves solving complex engineering problems** |
| **CO4-PO2** | **H** | **Principles of mathematics and engineering sciences are used in various aspects of Cyber security systemsArchitecture** |
| **CO4-PO3** | **H** | **Knowledge of Cyber security systemsarchitecture can be used to design and develop solutions for complex engineering problems** |
| **CO4-PO4** | **L** | **Cyber security systems Architecture knowledge can be used to design and conduct experiments to provide valid conclusions** |
| **CO4-PO9** | **L** | **Expertise developed, which will enable the student to become a productive member of a design team** |
| **CO4-PO12** | **M** | **The student will become aware of the need for lifelong learning and the continued upgrading of technical knowledge** |
| **CO5-PO1** | **H** | **Performance analysis involves solving complex engineering problems** |
| **CO5-PO2** | **H** | **Performance analysis involves principles of mathematics and engineering** |
| **CO5-PO3** | **H** | **Performance Analyis can be used to design and develop solutions for complex engineering problems** |
| **CO5-PO4** | **H** | **Performance analysis skills can be used to design and conduct experiments to provide valid conclusions** |
| **CO1-PSO2** | **M** | **Students can code, simulate and test functional blocks of various scanning tools** |
| **CO1-PSO3** | **L** | **Recognize the importance of continuous learning** |

| | | |
|---|---|---|
| **CO2-PSO1** | **L** | **Complete or partial design of cyber systems with tools** |
| **CO2-PSO2** | **M** | **Students can code, simulate and test functional blocks of cyber systems with tools** |
| **CO2-PSO3** | **L** | **Recognize the importance of continuous learning** |
| **CO3-PSO1** | **M** | **Usage and also development of various tools involves programming** |
| **CO3-PSO2** | **L** | **Usage and also development of various tools involves programming** |
| **CO3-PSO3** | **L** | **Recognize the importance of continuous learning** |
| **CO4-PSO1** | **L** | **IO and memory designs can be used in the systems used for cyber communication** |
| **CO4-PSO2** | **L** | **IO and Memory designs can simulated and analyzed using cyber communication** |
| **CO4-PSO3** | **L** | **Recognize the importance of continuous learning** |

**GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:**

| SL NO | DESCRIPTION | PROPOSED ACTIONS | RELEVANCE WITH POs | RELEVANCE WITH PSOs |
|---|---|---|---|---|
| **1** | **Various scanning tools simulation** | **Tool discussion** | | |

**TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:**

| SL NO | DESCRIPTION | PROPOSED ACTIONS | RELEVANCE WITH POs | RELEVANCE WITH PSOs |
|---|---|---|---|---|
| **1** | **Various scanning** | **Lectures** | **1** | **-** |

**WEB SOURCE REFERENCES:**

| | |
|---|---|
| **1** | **http://nptel.iitm.ac.in** |

**DELIVERY/INSTRUCTIONAL METHODOLOGIES:**

| | | | |
|---|---|---|---|
| ☐ **CHALK & TALK** | ☑ **STUD. ASSIGNMENTS** | ☑ **WEB RESOURCES** | ☑ **ONLINE CLASSES** |
| ☑ **LCD/SMART BOARDS** | ☐ **STUD. SEMINARS** | ☐ **ADD-ON COURSES** | |

**ASSESSMENT METHODOLOGIES-DIRECT**

| | | | |
|---|---|---|---|
| ☑**ASSIGNMENTS** | ☐ **STUD. SEMINARS** | ☑ **TESTS/MODEL EXAMS** | ☑ **UNIV. EXAMINATION** |
| ☐ **STUD. LAB PRACTICES** | ☐ **STUD. VIVA** | ☐ **MINI/MAJOR PROJECTS** | ☐ **CERTIFICATIONS** |
| ☐ **ADD-ON COURSES** | ☐ **OTHERS** | | |

**ASSESSMENT METHODOLOGIES-INDIRECT**

| | |
|---|---|
| ☑ **ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)** | ☑ **STUDENT FEEDBACK ON FACULTY (TWICE)** |
| ☐ **ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS** | ☐ **OTHERS** |

**Prepared by**

**ECE)**

**Mariya Vincent**

**(Faculties in Charge)**

**Approved by**

**Dr. Rithu James**

**(HOD,**

# COURSE PLAN

| UNIT | DETAILS | HOURS |
|---|---|---|
| I | **Introduction to Vulnerability Scanning Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit.** | **7** |
| II | **Network Vulnerability Scanning Networks Vulnerability Scanning - Netcat, Socat, understanding Port and Services tools - Datapipe, Fpipe, WinRelay, Network Reconnaissance – Nmap, THC-Amap and System tools, Network Sniffers and Injection tools – Tcpdump and Windump, Wireshark, Ettercap, Hping, Kismet** | **7** |
| III | **Network Defense tools Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection** | **8** |
| IV | **Web Application Tools Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap. DVWA, Webgoat, Password Cracking and Brute-Force Tools – John the Ripper, L0htcrack, Pwdump, HTCHydra** | **6** |
| V | **Introduction to Cyber Crime and law Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world, A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000.** | **8** |
| VI | **Introduction to Cyber Crime Investigation Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks** | **6** |
| **TOTAL HOURS** | | **24** |

# SAMPLE QUESTION

## Module 1

1. What do you mean by 'vulnerability scanner'? Draw and explain its architecture.
2. Describe the term Banner/Version check.
3. Explain how Metasploit helps to target a system and helps an attacker tocompromise a system?

## Module 2

1. Describe Socat as a network vulnerability scanning tool?
2. Explain the concept of Network Reconnaissance and describe any tool that support it
3. Explain the role of cygwin in Netcat.
4. List the features of NETCAT and SOCAT.
5. Explain the working of WinRelay.

## Module 3

1. What do you understand by HTTP Utilities? Describe a description on OpenSSL and Curl.
2. Explain the concepts of password cracking? What all measures should be taken to protect our password?
3. What do you understand by sqlmap? Explain the role of Webgoat in protecting web applications.
4. What do you mean by Brute-Force Attack? Explain L0htcrack tool that assist in Brute-Force Attacks. (2+2)
5. Describe W3af as a tool for scanning web vulnerabilities.

## Module 4

1. Explain the concept of NAT.
2. Write short note on Virtual Private Networks.
3. Describe the packet characteristics that need to be followed by packet filters and firewall.

## Module 5

1. Explain the architecture of Firewall. What are the various characteristics of Firewall?
2. "Understanding and implementing Incident Response can reduce the risk of cyber attacks." Explain
3. What do you understand by DOS and DDOS attacks?
4. What do you understand by the term "Steganography" ?

## Module 6

1. Explain Indian IT ACT 2000.
2. Explain problems associated with computer crime.
3. What are keyloggers? Differentiate between hardware and software keyloggers
4. Explain what all attacks occur on wireless networks.

# EC 492

# PROJECT

# COURSE INFORMATION SHEET

| | |
|---|---|
| PROGRAMME: UG PROGRAMME IN ELECTRONICS & COMMUNICATION ENGINEERING | DEGREE: BTECH |
| COURSE: PROJECT | SEMESTER: VIII CREDITS: 6 |
| COURSE CODE: EC 492 REGULATION: 2015 | COURSE TYPE: CORE |
| COURSE AREA/DOMAIN: ELECTRONICS AND COMMUNICATION | CONTACT HOURS: 18 hours/Week. |
| CORRESPONDING LAB COURSE CODE (IF ANY): | LAB COURSE NAME: |

**SYLLABUS:**

| UNIT | DETAILS | HOURS |
|---|---|---|
| I | 30%-50% Project Work | 10 |
| II | 50%-75% Project Work | 10 |
| III | 75%-100% Project Work | 10 |
| IV | Evaluation - 100% Project Work | 10 |
| V | Report submission | 6 |
| | TOTAL HOURS | 46 |

**COURSE PRE-REQUISITES:**

| C.CODE | COURSE NAME | DESCRIPTION | SEM |
|---|---|---|---|
| EC202 | Signals &Systems | Basics of signals and systems | IV |
| EC207 | Logic Design Circuit | Basics of Logical design | IV |
| EC208 | Analog Communication Engineering | Basics of Analog Communication | IV |
| EC302 | EC302 Digital Communication | Basics of Digital Communication | VI |
| EC403 | Microwave & Radar Engineering | Basics of MW devices and Radar systems | VII |

**COURSE OBJECTIVES:**

| | |
|---|---|
| 1 | To apply engineering knowledge in practical problem solving |
| 2 | To foster innovation in design of products, processes or systems |
| 3 | To develop creative thinking in finding viable solutions to engineering problems |

**COURSE OUTCOMES:**

| S NO | DESCRIPTION |
|---|---|
| 1 | Think innovatively on the development of components, products, processes or technologies in the engineering field |
| 2 | Apply knowledge gained in solving real life engineering problems |

**CO-PO-PSO MAPPING:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 492.1 | | 3 | 3 | 2 | 3 | | | | 2 | 2 | 2 | | 3 | | 3 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 492.2 | 3 | | 3 | | | 2 | 1 | 2 | | | | 2 | | 3 | |

**JUSTIFICATIONS FOR CO-PO MAPPING**

| Mapping | LOW/MEDIUM/HIGH | Justification |
|---|---|---|
| C01-P02 | H | Projects help the students to think innovatively and define a problem. They perform problem analysis and bring up solutions using the fundamentals they have studied. |
| CO1-PO3 | H | The students propose solutions to the problem they have identified in a recent research area of their interest. They design/develop solutions using software and hardware which caters to the needs of the society. |
| CO1-PO4 | M | The students conduct analysis of their results with the existing ones and based on their interpretations provide valid conclusions as well as future work in the area. |
| CO1-PO5 | H | The students study and make use of modern tools (software) to develop the solutions to complex problems. |
| CO1-PO9 | M | The students develop the solution or product after brainstorming sessions with their team mates. This fosters individual and team work. |
| C01-P10 | M | The students present their project work during every stages of their work to the guide and other panel members. They also write reports which explain the project. This enhances their communication and comprehension skills. |
| CO1-P11 | M | The students are able to apply the management principles when they are working as a team. They also become acquainted to work adhering to timelines as well as multidisciplinary environment. |
| CO1-PSO1 | H | The students are able to analyze and design solutions for the problems they have identified for their project using the principles of computer science. |
| CO1-PSO3 | H | The students are able to propose and implement innovative solutions to complex problems which helps to develop research and entrepreneur ship skills. |
| CO2--P01 | H | The students are able to apply the knowledge of all the fundamental courses they have studied in their project implementations. This also helps them to understand the practical aspects of the theory that they have studied in these courses. |
| CO2-PO3 | H | The students are able to design and develop solutions for the problem defined. The solution will cater to the needs of the society as well as environment. |

| | | |
|---|---|---|
| CO2-P06 | M | The students will be able to apply the reasoning to the issues that they see in the society as they have used their logic and skills in the design and analysis of the problem defined. They will also be aware of the responsibilities of a professional engineer |
| C02-PO7 | L | The students develop and design the solution taking into consideration the impact of their solution to society and environment. |
| CO2-PO8 | M | The students working as a team in a project are able to develop the professional ethics that they need during their professional career. |
| CO2-PO12 | M | The students will be able to utilize their skill of analyzing a context or a problem developed as part of their project in a broader sense during new technology developments which helps in solving real world problems. |
| CO2-PSO2 | H | The students are able to enhance their programming skills , apply recent principles of project development and deliver products/ hardware needed. This helps them to solve real world problems in their future professional career. |

**WEB SOURCE REFERENCES:**

| | |
|---|---|
| 1 | www.ieexplorer.ieee.org |
| 2 | www.springer.com |
| 3 | www.hindawi.com |

**DELIVERY/INSTRUCTIONAL METHODOLOGIES:**

| | | | |
|---|---|---|---|
| □CHALK & TALK | □STUD. ASSIGNMENT | ■ WEB RESOURCES | |
| ■ LCD/SMART BOARDS | ■ STUD. SEMINARS | □ ADD-ON COURSES | |

**ASSESSMENT METHODOLOGIES-DIRECT** [Append details of assessment methodologies actually employed (including design and analysis assessment) in spreadsheet format after the completion of each semester]

| | | | |
|---|---|---|---|
| □ ASSIGNMENTS | ■ STUD. SEMINARS | □ TESTS/MODEL EXAMS | □UNIV. EXAMINATION |
| □ STUD. LAB PRACTICES | ■ STUD. VIVA | ■ MINI/MAJOR PROJECTS | □ CERTIFICATIONS |
| □ ADD-ON COURSES | □ OTHERS | | |

**ASSESSMENT METHODOLOGIES-INDIRECT**

| | |
|---|---|
| ■ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE) | ■ STUDENT FEEDBACK ON FACULTY (TWICE) |
| □ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS | □ OTHERS |

**Prepared by**
**by**
**(Faculty)**
**Preethi Bhaskaran**
**James**
**Bonifus P L**
**Anoop Thomas**

**Approved**

**(HOD)**
**Dr Rithu**

# Department of Electronics and Communication Engineering

## Guidelines for EC 451 Seminar & Project Prelimary & EC 492 Project

1. **General Guidelines**

- Each project group will typically comprise of 3 or 4 students from the same class.
- The seminar and project work will both be supervised by an allotted Project Guide.
- Seminar is considered to be the literature survey for the Project. Students are expected to select seminar topics related to their chosen project area.
- Each student is instructed to refer a minimum of 3 SCI-Indexed Journal Papers and a minimum of 4 Conference papers for the Seminar & Project work.
- As a part of the Project Preliminary work, each Project group is expected to demonstrate a part of their Project, as defined by the Project Guide. The work must include design/research content.
- The evaluation of EC 451 Seminar & Project Preliminary presentations will be conducted in two phases:
    - Phase-I: Each student will be given 20 minutes for the Seminar Presentation(15 minutes) + Q & A session(5 minutes)
    - Phase-II: Each Project group will be provided 30 minutes to present the Project Preliminary work. Presentation(20 minutes) + Q & A session(10 minutes)

2. **General Guidelines for guides**

- Guides can change /modify the topics proposed by the students.
- Guides must ensure that the final proposed work can be properly divided in to group members.
- After allocation weekly wise student- guide interaction is expecting and students must report the interaction through project diary (currently soft copies).
- If the project contains an interdisciplinary part guide can take support of co guides from other research groups/department.

3. **Student-Guide interaction**

a. Project Diary

Every student has to maintain a project diary in which he/she is expected to record the project activities. Department views this as an important exercise and so should be properly recorded and maintained till the end of the final year project. The project diary (College size note book minimum 200 pages) must include:

- Syllabus of the EC 451 & EC 492 courses.
- Instructions and schedule given in between the course.
- Print out of the seminar paper selected for seminar from the list of 7 to 10 papers referred.
- List of referred papers.
- Project schedule showing planned completion date for each major activity as well as actual date of completion of the activity.
- Daily/weekly record of work done and summary of interaction/discussions with Project Guide, duly signed by the Project Guide.

- Responsibilities of each member of the project team properly defined.
- Questions asked during the interim presentations and the answers.
- Difficulties/challenges faced, if any, and steps taken to overcome them.

**The project diary should be updated and the signature of the Project Guide should be obtained every week.**

Every student should carry the updated project diary to the project lab. The project diary should be shown to the members of the faculty-in-charge of the Project hour as and when demanded.

b) Time for interaction:

No Student is expected to miss regular classes for project discussions. It is also recommended that the students try to capitalize the time that they get soon after the completion of S7 final exams.

The respective Project Guide should be intimated in advance by the students about the date and time of presentation/review.

b. Responsibilities

The completion of the project is the responsibility of the group. The group should take the advice and directions from the Project Guide in achieving this.

## 4. Project schedule

The important dates for the different stages of project implementation will be provided. The individual schedule of their seminar/project has to be prepared by the students in consultation with the Project Guide.

## 5. Project Quality Management

The project work done by the student is one of the criteria for employment in good companies. This makes it imperative for the department to make sure about the quality of the work being carried out. The project work carried out should be presentable in front of a technically competent audience.

## 6. Seminar/Project Report Writing

- The Project Diary should be referred to while preparing the Seminar/Project Report.
- Seminar/Project Report should be prepared in LaTeX.
- The standard format of Report will be made available to the students which should be accurately followed.

- Writing of the report should be done with the involvement of each member of the group and the Project Guide and it should be an individual report for both Seminar/Project.
- It is good to start writing rough reports early during the project phase. These rough reports may be submitted to the Project Guide for correction. This will save time and effort later when the semester is about to end and time becomes very crucial.
- No final copy of the report will be signed by the Project Guide until he/she is convinced of the originality of the report and that the corrections recommended by him/her have been carried out. The responsibility of this will solely lie with every member of the Project group.

## 7. Paper presentation

- The department has decided to make technical paper writing compulsory for all Project Groups.
- This will also help the students to get an edge over other students during interviews.
- The papers will be compiled and kept in the department as record / for future enhancements.
- Include the name of guides and co-guides and acknowledge if any external support.