### Autonomous Program Structure of Final Year B. Tech. Eight Semester (Electronics and Telecommunication Engineering)

**Academic Year: 2023-2024 onwards**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Teaching Scheme Hours /Week</th>
<th>Examination Scheme</th>
<th>Total Marks</th>
<th>Credit</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td>Lecture</td>
<td>Tutorial</td>
<td>Practical</td>
<td>In Sem</td>
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<tr>
<td>20EC801</td>
<td>Broadband Communication Systems (BCS)</td>
<td>3</td>
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<tr>
<td>20PEEC801</td>
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<tr>
<td>20PEEC802</td>
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<td>3</td>
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<tr>
<td>20OE 801</td>
<td>Open Elective-III</td>
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<tr>
<td>20OE 802</td>
<td>Open Elective-IV*</td>
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<td>20EC801L</td>
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**Total**          |                                           | 15      | 0        | 4         | 300    | 250     | 25        | 25   | 600     | 17     |

**Grand Total**    | 19                                        | 550     | 50       |           |        |         |           |      |         |        |

**Programme Elective-IV**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Sr. No.</th>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>20PEEC801A</td>
<td>Microwave and Radar Engineering (MRE)</td>
<td>1</td>
<td>20PEEC801A</td>
<td>Microwave and Radar Engineering (MRE Lab)</td>
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<tr>
<td>2</td>
<td>20PEEC801B</td>
<td>Remote Sensing (RS)</td>
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<td>20PEEC801B</td>
<td>Remote Sensing (RS Lab)</td>
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<tr>
<td>3</td>
<td>20PEEC801C</td>
<td>Industrial Automation (IA)</td>
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<td>Industrial Automation (IA Lab)</td>
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<tr>
<td>4</td>
<td>20PEEC801D</td>
<td>Embedded RTOS (ERTOS)</td>
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**Programme Elective-IV Lab**

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<tr>
<th>Sr. No.</th>
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<td>20PEEC801A</td>
<td>Microwave and Radar Engineering (MRE)</td>
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**Programme Elective-V**

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<tbody>
<tr>
<td>1.</td>
<td>20PEEC802A</td>
<td>Advanced VLSI Design (AVLSI)</td>
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<tr>
<td>2.</td>
<td>20PEEC802B</td>
<td>Artificial Intelligence (AI)</td>
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<tr>
<td>3.</td>
<td>20PEEC802C</td>
<td>Statistical Signal Processing (SSP)</td>
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<tr>
<td>4.</td>
<td>20PEEC802D</td>
<td>Mobile Communication (MC)</td>
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<table>
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<th>Sr. No.</th>
<th>Course Code</th>
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<th>EnTC</th>
<th>Comp</th>
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<tr>
<td>1</td>
<td>20OE801A</td>
<td>Big Data and Analytics</td>
<td>Y</td>
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<td>Cyber Physical Systems</td>
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<td>Renewable Energy Sources</td>
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<td>Software Testing and Quality Assurance</td>
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### 20OE802 Open Elective-IV

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<th>Sr. No.</th>
<th>Course Code</th>
<th>Course Title</th>
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<th>Mech</th>
<th>Instru</th>
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<tbody>
<tr>
<td>1</td>
<td>20OE802A</td>
<td>Applied statistics with R Programming</td>
<td>Y</td>
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<td>Industrial Drives and Control</td>
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20EC801 BROADBAND COMMUNICATION SYSTEMS

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: 20EC402 Analog and Digital Communication

Course Objectives:
1. To comprehend the components of fibre optic communication system
   To understand the system design issues and the role of WDM components in advanced light
2. wave systems
3. To describe optical network architectures
4. To explain the concepts of new services and applications to be supported in future satellite networks

Course Outcomes:
After completion of the course, students will be able to

CO1 Describe the effect of propagation characteristics of Optical communication system
CO2 Apply system design considerations for optical link
CO3 Describe optical access networks
CO4 Design WDM optical network
CO5 Identify and access sources for recent trends in Broadband Communication

Unit I: Fiber optic communications system (08)

Unit II: Design considerations in optical links and Wavelength Division Multiplexing(WDM) (06)
Point to point Links: System design considerations, Link Power budget, Rise Time budget, Overview of WDM, WDM Components: Fiber Coupler, Optical Isolators and Circulators, Optical Fiber Applications.

Unit III: Optical Network Architectures (07)

Unit IV: WDM Network Design (07)
Unit V: Multiprotocol Label Switching (MPLS) Networks (07)
Introduction to MPLS, MPLS and Traffic Engineering, Integrated service Internet, RSVP, Differentiated service Internet, Voice over IP, Metro Ethernet Access networks.

Unit VI: Next Generation Internet (NGI) Over Satellite (07)

Text Books:

Reference Books:

Online Resources:
1. NPTEL Course "Fiber Optic Communication Technology"
   https://nptel.ac.in/courses/108/106/108106167/
2. NPTEL Course “Satellite Communication Systems”
   https://nptel.ac.in/courses/117/105/117105131/
3. NPTEL Course “Broadband Networks: Concepts and Technology”
   https://nptel.ac.in/courses/117/101/117101050/
Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: 20EC601 Wave Theory and Antenna

Course Objectives:
1. To study the basics of waveguides and various microwave components
2. To analyze microwave components using scattering parameters
3. To study various microwave measurement techniques
4. To explain different types of Radars and its applications

Course Outcomes:
After completion of the course, students will be able to
CO1 Discuss the advantages and applications of microwaves
CO2 Analyze different modes of propagation in waveguides
CO3 Derive and analyze S parameters for different microwave components
CO4 Explain the operation of different microwave tubes
CO5 Calculate and analyze parameters at microwave frequencies
CO6 Discuss the principle of Radar and compare different types of Radars

Unit I: Microwave Transmission Lines (08)
Introduction of Microwaves and their applications, Rectangular waveguides, Solution of Wave equation in TE and TM modes, Power transmission and Power losses, Planar transmission lines.

Unit II: Waveguide Components (08)
Scattering matrix representation of networks, Rectangular cavity resonator, Waveguide Tees, Directional couplers, Faraday rotation principle, Circulators and isolators.

Unit III: Microwave Tubes (08)
Introduction to conventional vacuum tubes, High frequency limitations of conventional tubes, Klystron tubes, Magnetron, TWT and their applications.

Unit IV: Microwave Measurements (06)
Introduction to microwave measurements, Measurement methods of parameters such as Frequency, Power, Attenuation, Phase shift, VSWR, Impedance, Insertion loss, Q of a cavity resonator.

Unit V: Radar Fundamentals (06)
Radar block diagram and operation, Radar range equation, Prediction of range performance, Minimum detectable signal, Radar cross section of targets, Pulse repetition frequency and Range ambiguities, Radar Displays.

Unit VI: Types of Radar and Applications (06)
Types of Radars, Doppler effect, CW radar, basic principle and operation of FMCW radar, MTI and Pulse Doppler Radar.
Text Books:

Reference Books:

Online Resources:
1. NPTEL Course on “Microwave Theory and Techniques”
   https://onlinecourses.nptel.ac.in/noc19_ee57/preview
2. NPTEL Course on “Basic Blocks of Microwave Engineering”
   https://nptel.ac.in/courses/117105130/
20PEEC801B  REMOTE SENSING

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: PEEC 501 Digital Image Processing, 20EC403 Machine learning with Python

Course Objectives:
1. To understand basic concepts, principles and applications of remote sensing
2. To provide knowledge related to remote sensing data collection, reading and analysis
3. To perform image pre-processing, classification and clustering on remote sensing data
4. To learn multidisciplinary applications of remote sensing

Course Outcomes:
After completion of the course, students will be able to
CO1 Explain geometric and radiometric principles, Digital Image Processing techniques for pre-processing of Remote Sensing image data
CO2 Illustrate atmospheric and energy interaction, scanning mechanism on earth surface
CO3 Interpret data products from different satellites and calculate image statistics
CO4 Apply machine learning algorithms for dimensionality reduction, clustering and classification on satellite images
CO5 Analyze performance of different machine learning algorithms on multispectral and hyperspectral images
CO6 Demonstrate multidisciplinary applications of remote sensing

Unit I:  Introduction to Remote Sensing (08)

Unit II:  Multispectral, Thermal, and Hyperspectral Sensing (08)
Platforms used for Remote Sensing data acquisition and characteristics, Different types of aircrafts, Manned and Unmanned spacecrafts, Sun-synchronous and geo-synchronous satellites, Types and characteristics of different platforms, Opto-mechanical and electro-optical sensors: across-track and along-track scanners, Multispectral scanners and Thermal scanners, Imaging spectroscopy.

Unit III:  Data Representation and Preprocessing (09)
Resolution: spatial, spectral, radiometric and temporal resolution, Data products and their characteristics, Visual and digital interpretation, Image statistics, Basic principles of data processing: Radiometric correction, Geometric correction, Atmospheric errors and corrections, Image enhancement.

Unit IV:  Data Analysis (09)
Unit V: Applications of Remote Sensing (08)

Hyperspectral image analysis, Multispectral image analysis, Time Series Analysis using machine learning techniques in different application areas as urban planning, agricultural, forestry and disaster management.

Text Books:

Reference Books:

Online Resources:
1. NPTEL Course “Remote Sensing and Digital Image Processing of Satellite Data”
   https://nptel.ac.in/courses/105/107/105107160/
2. NPTEL Course “Remote Sensing Essentials”
   https://nptel.ac.in/courses/105/107/105107201/
3. https://www.iirs.gov.in
Prerequisite:

Course Objectives:
1. To introduce the basics of process control and automation systems
2. To explain the essential elements as required for a process control system
3. To introduce the basics of P.L.C. programming and P.L.C. programming standard
4. To familiarize with SCADA and DCS

Course Outcomes:
After completion of the course, students will be able to:
CO1 Explain the basics of a Process Control System and Automation System
CO2 Design subsystems of a Process Control application
CO3 Develop P.L.C. ladder diagram for process control application
CO4 Explain communication in P.L.C. (Programmable Logic Control), SCADA (Supervisory Control and Data acquisition) and DCS (Distributed Control System)

Unit I: Process Control and Automation (08)

Unit II: Transmitters and Signal Conditioning (08)

Unit III: Controllers and Actuators (09)

Unit IV: Programmable Logic Controller (09)

Unit V: Industrial Automation Technologies: Supervisory Control And Data Acquisition (S.C.A.D.A.) and Distributed Control System (D.C.S.), Industrial Communication
Introduction to S.C.A.D.A. (Features, MTU-functions of MTU, RTU-Functions of RTU, Applications of S.C.A.D.A., Communication in S.C.A.D.A.: types, methods and Media used), Introduction to DCS (Architecture, Input and Output modules, Communication module,

Text Books:

Reference Books:

Online Resources:
1. NPTEL Course on Industrial Automation and Control
   https://onlinecourses.nptel.ac.in/noc21_me67/preview
20PEEC801D EMBEDDED DESIGN AND RTOS

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite: 20EC503 Advanced Processors, 20ES02 Fundamentals of Programming Language I

Course Objectives:
1. To discuss embedded system design challenges
2. To explain Operating System (OS) requirement for embedded systems
3. To describe real time operating system concepts
4. To discuss features of Linux OS
5. To interface real world input and output devices

Course Outcomes:
After completion of the course, students will be able to
CO1 Identify and analyse design metrics for development of embedded system
CO2 Select and apply Software development life cycle for given application
CO3 Apply real time operating system concepts for developing software of embedded systems.
CO4 Explain Linux OS architecture

Unit I: Introduction to Embedded Systems (07)

Unit II: Structure of μCOS II (07)
Kernel Structure: Foreground and background systems, Pre-emptive and Non-Preemptive, Starting the OS, Tasks, Task States, Task Control Blocks (TCB), Ready list, Task Scheduling, Task Level, Multitasking, Context Switching, Idle Task, Statistics Task, Task Management: Creating/Deleting and Suspending/Resuming Task, Task Stacks and checking, Changing Task’s Priority.

Unit III: Synchronization in μCOS II (07)

Unit IV: Structure of μCOS II (07)
Static and Dynamic Priorities, Priority inversion, Synchronization mechanism, Interrupts: Latency, Response and Recovery, Clock Tick, Memory requirements. Schedulers, Locking and unlocking of scheduler, Interrupts, Clock Tick, Initialization, Time Management: Delaying/Resuming task, System Time.
Unit V: Communication in μCOS II
(07)
Message Mailbox Management: Creating/Deleting a Mailbox, Waiting/Sending/Getting without waiting a Message from Mailbox, Status of Mailbox, and Alternate uses of Mailbox, Message Queue Management: Creating/Deleting/Flushing a Message Queue, Waiting/Sending/Getting without waiting a Message from Queue, Status and Alternate use of Message Queue, Memory Management: Memory Control Block(MCB), Creating a partition, Obtaining/Returning/Waiting for a memory Block, Partition Status, Porting of μCOS-II: Development tools, Directories and Files, Configuration and testing of Port.

Unit VI: Linux Kernel Construction
(07)

Text Books:

Reference Books:

Online Resources:
1. NPTEL Course on “Real Time Operating System”
   https://onlinecourses.nptel.ac.in/noc20_cs16/
2. NPTEL Course on “Real-Time Systems”
   https://onlinecourses.nptel.ac.in/noc21_cs98/
20PEEC802A ADVANCED VLSI DESIGN

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: 20EC502 VLSI Design

Course Objectives:
1. To discuss the coverage of timing analysis
2. To study the fundamentals of static timing analysis
3. To understand logic fault models and learn test generation for sequential and combinational logic circuits
4. To learn power distribution and power optimization techniques

Course Outcomes:
After completion of the course, students will be able to
CO1 Apply the timing constraints, including clocks and external delays for performance improvement
CO2 Apply Static Timing Analysis (STA) checks for timing closure
CO3 Analyze the faults in digital circuits
CO4 Analyze the design for testability methods for combinational and sequential circuits
CO5 Describe power distribution and power optimization techniques

Unit I: Introduction to Timing Analysis (08)
Performance axes, Design flow, Static versus dynamic methods, Intrinsic and extrinsic delays, Delay factors, Path delays, Combinational paths, Synchronous paths, Pipelining and analysis, Clock definitions: Skew, Frequency and phase, Clock distribution.

Unit II: Static Timing Analysis (08)

Unit III: Basics of Testing (08)
Fault models, Combinational logic and fault simulation, Test generation for Combinational Circuits, Current sensing based testing, Classification of sequential ATPG methods, Fault collapsing and simulation.

Unit IV: Design for Testability (DFT) (08)
Scan design, Partial scan, Use of scan chains, Boundary scan, DFT for other test objectives, Memory Testing. Built-in self-test (BIST): Pattern Generators, Estimation of test length, Test points to improve testability, Analysis of aliasing in linear compression, BIST methodologies, BIST for delay fault testing.
Unit V: Power Analysis and Clock Synthesis (10)


Text Books:

Reference Books:

Online Resources:
1. NPTEL Course “Advanced VLSI Design”
   https://nptel.ac.in/courses/117/101/117101004/
2. NPTEL Course “VLSI Physical Design”
   https://nptel.ac.in/courses/106/105/106105161/
20PEEC802B ARTIFICIAL INTELLIGENCE

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite: 20EC403 Machine Learning with Python

Course Objectives:
1. To explain the basics of Artificial Intelligence
2. To introduce various types of algorithms useful in Artificial Intelligence
3. To explain the types of reasoning
4. To explain the code of ethics for Artificial Intelligence

Course Outcomes:
After completion of the course, students will be able to
1. Explain the components of intelligent agents and expert systems
2. Apply knowledge representation techniques and problem solving strategies to Artificial Intelligence applications
3. Explain and analyze the search and learning algorithm along with the reasoning
4. Describe the code of ethics for the Artificial Intelligence systems

Unit I: Basics of Artificial Intelligence (05)

Unit II: Problem Solving (07)
Problem solving agents, Searching for solutions, Uninformed search strategies, Informed search strategies, Heuristic function, Local search algorithms and optimistic problems, Optimal decisions in games, MINIMAX algorithm, Alpha Beta Pruning, Constraint satisfaction problems (CSP), Backtracking search and Local search for CSP.

Unit III: Knowledge Representation (07)
Logic, Propositional logic, First order logic, Knowledge engineering in first order logic, inference in first order logic, Prepositional versus first order logic, Forward chaining, backward chaining, Resolution, Knowledge representation, Uncertainty and methods, Bayesian probability and Belief network.

Unit IV: Reasoning (06)
Unit V: Learning (07)

Unit VI: Expert systems and Ethics for Artificial Intelligence (10)
Introduction to Expert System, Architecture and functionality, Examples of Expert system, Basic steps of pattern recognition system, Object Recognition- Template Matching theory, Prototype Matching Theory, Pattern Mining.

Text Books:

Reference Books:

Online Resources:
1. NPTEL Course “Artificial Intelligence” http://nptel.ac.in/courses/106105077/
20PEEC 802C STATISTICAL SIGNAL PROCESSING

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: 20EC501 Digital Signal Processing

Course Objectives:
1. To explain concepts of statistical signal processing that have been used in many applications fields such as communications, speech signal processing, image processing
2. To describe Signal Modeling methods and its importance in signal processing
3. To explain Parametric and non-parametric spectral estimation methods
4. To introduce Linear prediction and optimum filters and its necessity for noise filtering
5. To explore necessity of adaptive filters and algorithms for real time noise filtering

Course Outcomes:
After completion of the course, students will be able to

CO1 Apply statistical models for analysis of signals using Stochastic processes
CO2 Design Optimum filters for prediction and filtering of real world signals
CO3 Analyze real world signals by estimating its power spectral densities using parametric and non-parametric spectral estimation methods
CO4 Apply Adaptive filtering algorithms for real world signals

Unit I: Signal Modeling (08)
Random processes, Introduction to signal modeling, Signal modeling using Least Square methods, Pade’ method, Prony’s method, Signal modeling using MA(q), AR(p), ARMA(p,q) models.

Unit II: Linear Prediction of Signals (08)
Linear Prediction of Signals, Forward and Backward Predictions, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters, Linear Minimum Mean-Square Error (LMMSE) Filtering.

Unit III: Wiener Filter (08)

Unit IV: Adaptive Filtering (10)

Unit V: Spectral Analysis (08)
Estimated autocorrelation function, Periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Blackman and Tukey method of smoothing, Periodogram: Parametric method, AR(p) spectral estimation and detection of Harmonic signals, MUSIC algorithm.
Text Books:

Reference Books:

Online Resources:
1. NPTEL Course “Statistical Signal Processing”
   [https://nptel.ac.in/courses/108/103/108103158/](https://nptel.ac.in/courses/108/103/108103158/)
20PEEC 802D MOBILE COMMUNICATION

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: 20EC 402 Analog and Digital Communication

Course Objectives:
1. To explain the fundamentals of cellular system design and the techniques used to maximize the capacity of cellular network
2. To describe the basics of multi-path fading and various parameters used to characterize small scale fading
3. To explain various multiple access techniques
4. To explore the architecture and call processing of GSM and CDMA system

Course Outcomes:
After completion of the course, students will be able to
CO1 Explain the basics and design challenges of cellular networks
CO2 Analyze signal propagation issues and their impact on the communication system performance
CO3 Compare and determine capacity of different multiple access techniques
CO4 Describe the architecture, operation and call processing of GSM system
CO5 Describe CDMA system and analyze its design parameters

Unit I: Cellular Fundamentals (10)
Introduction to wireless Communication Systems, Evolution in cellular standards, Cellular concepts, Frequency reuse, Channel assignment, Handoff, Interference and System capacity, Trunking and Grade of service, Improving coverage and capacity.

Unit II: Mobile Radio Propagation (10)
Propagation mechanism, Free space path loss, Fading and Multipath, Small scale multipath propagation, Impulse response model of multipath channel, Parameters of mobile multipath channels, Types of small scale fading, Equalization techniques.

Unit III: Coding and Multiple Access Techniques for Wireless Communications (06)
Selection of Speech Coders for Mobile Communication, Linear Predictive Coders, Vocoders, GSM Codec, Multiple Access Techniques, Orthogonal Frequency Division Multiplexing (OFDM), OFDM applications.

Unit IV: Global System for Mobile Communications (08)
Evolution of Mobile standards, System Overview, The air interface, Logical and Physical channels, Synchronization, GMSK modulation, Call establishment, Handover.

Unit V: Code Division Multiple Access (08)
to 5G standard, Comparison between 4G and 5G.

**Text Books:**

**Reference Books:**

**Online Resources:**
1. NPTEL Course on “Introduction to wireless and cellular communication”
   [https://onlinecourses.nptel.ac.in/noc20_ee61/](https://onlinecourses.nptel.ac.in/noc20_ee61/)
20EC 801L  BROADBAND COMMUNICATION SYSTEMS LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
ISE: 25 Marks
ESE: Oral :25 Marks
Credits: 1

Course Objectives:
1. To interpret performance parameter of optical fiber
2. To interpret characteristics parameter for optical source and detector
3. To understand aspects of optical fiber communication link
4. To understand satellite communication link

Course Outcomes:
After completion of the course, students will be able to
CO1 Compute parameters of optical fiber: Numerical Aperture (NA), attenuation and bending losses
CO2 Illustrate characteristics parameters of optical source and detectors
CO3 Simulate power budget and rise time budget of optical link
CO4 Simulate Satellite scenario to measure BER and PER

List of Experiments:
1. Measure numerical aperture of optical fiber.
   Program to compare the acceptance angle for meridional ray and skew rays which change direction by 100 degrees at each reflection.
2. Program to Estimate the a) delay difference between the slowest and fastest modes at the fiber output  b) the rms pulse broadening due to dispersion c) the maximum bitrate and bandwidth supported.
3. Program to determine the total carrier recombination lifetime, the power internally generated.
   Plot V-I characteristics of LED used in optical fiber communication.
4. Program to determine Quantum efficiency and responsivity of photodiodes.
   Compare performance of APD for different load resistors and biasing voltage.
5. Simulate Power budget and Rise time budget analysis of optical fiber system
6. Program to design wavelength channel plan for
   (a) 8 band, 32 channel dense WDM Interleave Waveband Filter band.
   (b) The overall bandwidth of the filter  in each case.
7. End-to-End DVB-S2 Simulation with RF Impairments and Corrections.
8. Satellite link design/ Model, Visualize, and Analyze Satellite Scenario.
20PEEC 801LA MICROWAVE AND RADAR ENGINEERING LAB

Teaching Scheme
Lectures: 2 Hours / Week

Examination Scheme
ISE: 25 Marks
ESE: Practical: 25 Marks
Credits: 1

Course Objectives:
1. To learn reciprocal and non-reciprocal passive microwave components.
2. To learn the characteristics of active devices like reflex klystron and Gunn diode.
3. To learn the nature of standing waves formed due to impedance mismatch.
4. To learn the working principle of Radar.

Course Outcomes:
After completion of the course, students will be able to
CO1 Measure and Analyze the characteristics of reciprocal and non-reciprocal passive microwave components.
CO2 Analyze the characteristics of various microwave sources like Reflex Klystron and Gunn Diode.
CO3 Analyze Standing waves for various terminations.
CO4 Simulation of Radar to measure range and speed of the target.

List of Experiments:
1. Measure and plot mode characteristics of the Reflex klystron.
2. Measurement of the free space wavelength of the microwave (for TE 10 mode) with the help of the X-band microwave test bench and verify with its theoretical calculation.
3. Measure VI characteristics of Gunn Diode and study of PIN modulator.
4. Measure and verify port characteristics of microwave tees (E, H, E-H or magic tee).
5. Measure and verify port characteristics of directional coupler and calculate coupling factor, insertion loss and directivity.
6. Measure and verify port characteristics of Isolator and Circulator. Calculate insertion loss and isolation in dB.
7. Measure wavelength of the microwave using a microwave test bench and verify with its theoretical calculations.
8. Plot a standing wave pattern and measure SWR for open, short and matched termination at microwave frequency using a slotted section with probe carriage.
9. To simulate the operation of Radar.
20PEEC801LB  REMOTE SENSING LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
ISE: 25 Marks
ESE: Practical: 25 Marks
Credits: 1

Course Objectives:
1. To introduce Geographic information system (GIS) software and operations on geo data using Quantum GIS (QGIS)
2. To provide knowledge about collecting and reading remote sensing data
3. To develop programming skills for satellite image analysis
4. To apply digital image processing and machine learning techniques on multispectral and hyperspectral images

Course Outcomes:
After completion of the course, students will be able to
CO1 Apply QGIS software for geospatial data analysis
CO2 Choose and apply image pre-processing and enhancement techniques on satellite images
CO3 Collect data from different satellites and apply data analysis steps using Python
CO4 Develop algorithms for clustering and classification of multispectral and hyperspectral images

List of Experiments:
1. (a) Introduction to Quantum GIS (QGIS) software, (b) Read and display satellite images, Process raster data and create composites.
2. Implement image enhancement techniques for satellite images.
3. Implement pan-sharpening algorithm on satellite data.
4. Develop an algorithm to perform data analysis on satellite images (Sentinel/Landsat)- Read data, Visualize bands, Plot histogram, Calculate vegetation and soil indices.
5. Develop an algorithm to perform dimensionality reduction and clustering in hyperspectral images.
6. Develop an algorithm for supervised classification in multispectral/hyperspectral images.
20PEEC801LC  INDUSTRIAL AUTOMATION LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
ISE: 25 Marks
ESE: Practical 25 Marks
Credits: 1

Course Objectives:
1. To demonstrate the measurement & control of a physical variable using an appropriate measurement and control circuit
2. To plot the response of Proportional (P), Proportional and Integral (PI) and PID Controllers
3. To introduce interfacing of I/O devices with PLC
4. To develop Ladder Program for Process Control Applications
5. To interface PLC with SCADA

Course Outcomes:
After completion of the course, students will be able to
CO1 Detect & control a physical variable using an appropriate measurement & control circuit
CO2 Plot the response of a Proportional, Proportional & Integral and PID Controllers
CO3 Interface I/O devices for a process control application with PLC
CO4 Develop PLC Ladder Programs for Process Control Applications
CO5 Interface PLC with RTU (Remote Terminal Unit) and SCADA

List of Experiments:
1. Temperature detection & control using RTD.
2. Temperature detection & control using Thermocouple.
3. Plotting step response of Proportional, Proportional & Integral and PID Controllers (Matlab based)
4. Interfacing of I/O devices (eg. Mechanical Switches, Relays) with PLC
5. Controlling the speed of Servo Motor using an analog voltage of 0-10V
6. Interfacing of PLC to Pneumatic Circuit
7. Developing PLC Ladder Programs for basic logical operations
8. Developing PLC program for a given Process Control Application
9. Interfacing PLC with RTU & SCADA at remote location.
20PEEC801LD EMBEDDED DESIGN AND RTOS LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
ISE: 25 Marks
ESE: Practical: 25 Marks
Credits: 1

Course Objectives:
1. Interface real world input and output devices
2. Discuss use of μCOS-II RTOS functions in programming
3. Explain porting of Linux OS

Course Outcomes:
After completion of the course, students will be able to
CO1 Interface real world input and output devices
CO2 Apply RTOS concepts to external peripheral devices
CO3 Write C program using RTOS functions
CO4 Port Linux OS in embedded system

List of Experiments:
1. Port μCOS-II RTOS on ARM7.
2. Multitasking in μCOS-II RTOS using min 4 tasks on ARM 7
3. Semaphore as Signaling and Synchronizing on ARM 7.
5. Implement MUTEX on ARM 7.
6. Use OS service(s) to accept keyboard input and display/transmit.
8. Write a program ‘Hello world; using embedded Linux on ARM 9.