

20HS701- Economics and Personal Finance

Teaching Scheme

Lectures: 2 Hrs/Week

Examination Scheme

In Semester: 50 Marks

End Semester: 50 Marks

Credits: 2

Prerequisite: Nil

Course Objectives:

1. To enable students to acquire knowledge and develop an understanding of basic concepts and principles of Economics & Finance
2. To make students acquaint with standard concepts and tools that they are likely to find useful in their profession when employed in the firm/industry/corporation in public or private sector
3. To sensitize students to the current economic issues of the nation
4. To develop an understanding of the role of institutions in the functioning of an economy
5. To understand Markets and behaviour of the firm
6. To enhance financial literacy of engineering students.

Course Outcomes:

After completion of the course, students will be able to

- CO1 Demonstrate the importance of National and International economy in ones economic life
- CO2 Analyse the behaviors of consumer, firms and market and its impact on corporate finance
- CO3 Apply financial techniques to evaluate companies and investments
- CO4 Develop Personal Financial strategies using various investment options and taxation

Unit I: Macro Economics : Understanding Indian Economy- Domestic and International (03)

Economics for Engineers, Definition and classification of Economics, Basic Economic Problems and Economic Systems, India Economy: Mixed economy, Sector-wise contributors Gross Domestic Product (GDP) of India, GDPs of other nations, Macroeconomics, Per Capita Income, Employment, Inflation calculation : Consumer Price Index (CPI), Wholesale Price Index (WPI), Fiscal Policy, Fiscal Deficit, Government expenditure and Taxation, Concept of Goods and Service Tax (GST), Monetary policy, Central Bank- Reserve Bank of India (RBI), Statutory Liquidity Ratio (SLR), Prime Lending Ratio (PLR), Cash Reserve Ratio (CRR).

Unit II: Microeconomics : Understanding behaviors of Consumers, Firms and Markets (05)

Consumer Behaviour, Concept of Demand and Supply, Determinants of Demand and Supply, Price Elasticity of Demand and Supply, Market Equilibrium and it's applications, Market and Market Structures- Perfect Competition, Monopolistic Competition, Oligopoly and Monopoly Cost Concepts, Product Costing and Pricing strategy.

Unit III: Personal Finance and Taxation I : Personal Financial strategies (06) **Background Concepts**

Financial analysis of a business firm: Statement of Profit and Loss, Balance Sheet, Analyzing various business firms through Ratio Analysis, Time value of money, Annuities. Calculations in Excel, International Trade and Comparative Advantage, International Financing : Foreign Exchange (FOREX) market and Exchange rates, Balance of Payment.

Unit IV: Personal Finance and Taxation II : Personal Financial strategies (07)
Goal Setting and Tax, Credit and Risk Management

Understanding Personal Finance : Financial Goal, Importance, Opportunity Costs in Decision Making, The Time Value of Money, Basics of Financial Planning, Personal financial statements, Cash flow and debt management, Tax Management : Taxes, Direct and Indirect, Income Tax slabs and sections, Other taxes, Credit Management : Consumer Loans, Credit cards, Credit Rating, Credit Information Bureau (India) Limited (CIBIL), Interest Rates, Understanding Monetary Policy, Risk Management : Insurance- Life and General, Types of life Insurance, Unit Linked Insurance Plan (ULIPS), Health Insurance, Vehicle Insurance and other major types, Understanding Insurance riders and decision making while buying insurance.

Unit V: Personal Finance and Taxation III : Personal Financial strategies (07)
Investments in Bonds, Stocks and Mutual Funds, Retirement Planning

Investment in Government Securities : Bank Accounts, Government Securities, Bonds, Fixed Deposits, Gold Bonds, Investment in Stock Market : Introduction to Stock Market, Stock Exchange Sensitive Index (SENSEX), National Stock Exchange (NSE), Dematerialised account (Demat) Account, How to select stocks- Price per Earning (P/E) ratio, Fundamentals analysis, Investment in Mutual Funds : What is Mutual Fund, Types, Exchange Traded Funds, Net Asset Value (NAV), Factors for selection of Mutual Funds, Retirement Planning : Public Provident Fund (PPF), Employee Provident Fund (EPF) , National Pension Scheme (NPS) and other Pension Funds, Annuity calculations.

Text Books:

1. Paul A Samuelson, "**Economics**", Indian Adaptation, Sudip Chaudhari, Anindya Sen, *Mc Graw Hill* (2010), 19th edition
2. Lawrence J Gitman, "**Principles of Managerial Finance**", *Pearson*.(2016) 11th edition
3. Prasanna Chandra , "**Finance Sense: Finance for Non-finance Executives**", 5th edition, CFMTMH professional series in Finance
4. Monika Halan , "**Let's Talk Money**" Harper Business 2018
5. P V Subramanya, "**Retire Rich**" TV18 Broadcast Ltd., 2019
6. Abhishek Kumar, "**The Richest Engineer**", Manjul Publishing House, 2016

Reference Books:

1. Lipsey, R.G. & Chrystal, K.A., "**Economics**", 11th Edition, Oxford University Press, 2007
2. K.K.Dewett, "**Modern Economic Theory**", S.Chand, 2005

Online Resources:

1. www.economicshelp.org
2. www.rbi.org
3. www.khanacademy.org

20EC801 BROADBAND COMMUNICATION SYSTEMS

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 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 wave
2. 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)

Electromagnetic Spectrum and Optical spectral bands, Key elements of fiber optic communications system, Ray theory of propagation: Fiber types, Transmission characteristics of optical fibers, Intra modal Dispersion, Intermodal dispersion. Introduction to optical sources: Wavelength and Material Considerations, LEDs and semiconductor LASERS: principle of working and their Characteristics, Material Considerations, PIN, Avalanche photodiodes.

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)

Architectural choices of next generation transport networks, Designing transmission layer using-SDM, TDM, WDM, Unidirectional versus Bidirectional WDM systems, SONET Layering, Frame Structure, Physical network topologies, Access Networks- PON, Optical Interconnects, Data Centers ,Optical communication for Wireless Fronthauling.

Unit IV: WDM Network Design (07)

Cost Trade-Offs: A Detailed Ring Network, Light path Topology Design, Routing and Wavelength Assignment(RWA), Wavelength Conversion, Dimensioning Wavelength-Routing Networks, Online RWA in Rings, Long Haul Network case study, Metro Ring Network Case study.

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)

Overview of satellite communication, New Services and Applications, Traffic Modeling and Characterization, IPv6 Networks over Satellites, Future Development of Satellite Networking.

Text Books:

1. Gerd Keiser, "**Optical Fiber Communications**", *Tata McGraw Hill*, (5th Edition), (2013).
2. John M. Senior, "**Optical Fiber Communications: Principles and Practice**", *PHI*, (3rd Edition), (2008).
3. Anthony S. Acampora, "**An Introduction to Broadband Networks LANs, MANs, ATM, B-ISDN, and Optical Networks for Integrated Multimedia**", *Springer US* (1st Edition), (1994).
4. Rajiv Ramaswami, Kumar N. Sivarajan, and Galen H. Sasaki, "**Optical Networks: A Practical Perspective**", *Morgan Kaufmann Publishers Inc*, (3rd Edition), (2010).
5. C. Siva Ram Murthy and Mohan Guruswamy, "**WDM Optical Networks: Concepts, Design and Algorithms**", *PHI*, (1st Edition), (2001).
6. Zhili Sun, "**Satellite Networking Principles and Protocols**", *John Wiley & Son*, (2nd Edition), (2014).

Reference Books:

1. Djafar K. Mynbaev and Lowell L. Scheiner, "**Fiber Optic Communications Technology**", *Pearson Education*, (1st Edition), (2000).
2. Govind P. Agrawal, "**Fiber Optic Communication Systems**", *Wiley India*, (3rd Edition), (2002).
3. Dennis Roddy, "**Satellite Communications**", *McGraw Hill*, (4th Edition), (2017).

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/>

20PEEC 801A MICROWAVE AND RADAR ENGINEERING

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 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:

1. S.Y. Liao, “**Microwave Devices and Circuits**”, *Prentice Hall India*, (2nd Edition), (2014).
2. M. Kulkarni, “**Microwave and Radar Engineering**”, *Umesh Publications*, (4th Edition), (2013).
3. M. I. Skolnik, “**Introduction to Radar Systems**”, *McGraw Hill*, (3rd Edition), (2008).

Reference Books:

1. David M. Pozar, “**Microwave Engineering**”, *John Wiley and Sons*, (5th Edition), (2014).
2. NadowLevanon, “**Radar Principles**”, *John Wiley and Sons*, (5th Edition), (1989).

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

In Semester: 50 Marks

End Semester: 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)

Energy sources and radiation principles, Energy interactions in the atmosphere, Characteristics and Physics of Remote Sensing systems, Electromagnetic spectrum, Effects of Atmosphere, Scattering and Absorption, Atmospheric window, Energy interaction with surface features: Spectral reflectance of Vegetation, Soil and Water, Atmospheric influence on spectral response patterns.

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)

Dimensionality reduction techniques, Image classification: Supervised classification, Unsupervised classification, Classification accuracy assessment, Image segmentation.

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:

1. Lillesand T.M., and Kiefer, R.W., “**Remote Sensing and Image interpretation**”, *John Wiley & Sons*, (6th Edition), (2000).
2. John R. Jensen, “**Introductory Digital Image Processing: A Remote Sensing Perspective**”, *Pearson*, (4th Edition), (2016).
3. George Joseph, “**Fundamentals of Remote Sensing**”, *Universities Press*, (2nd Edition), (2005).

Reference Books:

1. John A. Richards, “**Remote Sensing Digital Image Analysis**”, *Springer–Verlag*, (5th Edition), (2013).
Charles Elachi and Jakob J. Van Zyl, “**Introduction to The Physics and Techniques of Remote Sensing**”, *Wiley Series in Remote Sensing and Image Processing*, (2nd Edition), (2006).
2. JianGuo Liu, Philippa J. Mason, “**Image Processing and GIS for Remote Sensing: Techniques and Applications**”, *John Wiley & Sons, Ltd.*, (2nd Edition), (2016).

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>

20PEEC801C INDUSTRIAL AUTOMATION

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 50 Marks

Credits: 3

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)

Process control principles, Servomechanisms, Control System Evaluation, Analog control, Digital control, Types of Automation, Architecture of Industrial Automation Systems, Advantages and Limitations of Automation.

Unit II: Transmitters and Signal Conditioning (08)

Need of transmitters, Standardization of signals, Current, Voltage and Pneumatic signal standards, 2-Wire and 3-Wire transmitters, Analog and Digital signal conditioning for R.T.D., Thermocouple, Differential Pressure Transmitter (D.P.T.), Smart and Intelligent transmitters.

Unit III: Controllers and Actuators (09)

PID Controller, Cascade PID control, Microprocessor Based control, PAC (Programmable Automation Controller), Mechanical switches, Solid state switches, Electrical Actuators: Solenoids, Relays and Contactors, A.C. Motor, V.F.D., D.C. Motor, B.L.D.C. Motor, Stepper Motor, Servo Motor, Pneumatic and Hydraulic actuators.

Unit IV: Programmable Logic Controller (09)

Functions of P.L.C., Types of PLCs, Advantages, Architecture, Working of P.L.C., Selection of P.L.C., Networking of P.L.C.s, Ladder Programming basics, Ladder Programming examples, Interfacing Input and Output devices with P.L.C., P.L.C. Programming standard IEC61131.

Unit V: Industrial Automation Technologies : Supervisory Control And Data Acquisition (S.C.A.D.A.) and Distributed Control System (D.C.S.), Industrial Communication (08)

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,

Specifications), Industrial Communication: Devicenet, Interbus , Device network : Foundation Fieldbus -H 1, HART, CAN, PROFIBUS-PA, Control network: ControlNet, FF-HSE, PROFIBUS-DP, Ethernet, TCP/IP.

Text Books:

1. Curtis Johnson, "**Process Control Instrumentation Technology**", Pearson Education, (8th Edition), (2013).
2. S. Sen, S. Mukhopadhyay, A. K. Deb, "**Industrial Instrumentation Control and Automation**", Jaico Publishing House, (1st Edition), (2013).
3. Madhuchhanda Mitra, Samarjit Sengupta, "**Programmable Logic Controllers and Industrial Automation**", Penram International Publishing India Pvt. Ltd., (2nd Edition), (2012).
4. Stuart A. Boyer, "**SCADA (Supervisory Control and Data Acquisition)**", ISA Publication, (4th Edition), (2010).

Reference Books:

1. John W. Webb, Ronald A. Reis, "**Programmable Logic Controllers, Principles and Applications**", Prentice Hall of India Pvt. Ltd., (5th Edition), (2016).
2. Kilian, "**Modern Control Technology: Components & Systems**", Cengage India, (3rd Edition), (2021).
3. BelaG. Liptak, "**Process Software and Digital Networks**", CRC Press, (3rd Edition), (2011).

Online Resources:

1. **NPTEL Course on Industrial Automation and Control**
https://onlinecourses.nptel.ac.in/noc21_me67/preview

20PEEC801D EMBEDDED 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 analyze design metrics for development of embedded systems

CO2 Compare and contrast different types of software development model for a given application

CO3 Explore the structures, task services, states and other basic operations of the real time operating systems

CO4 Apply real time system concepts for developing embedded systems

CO5 Explain Linux kernel configuration and bootloader

Unit I : Introduction to Embedded Systems (07)

Introduction to Embedded Systems, Architecture, Classification and Characteristics of Embedded System, Design Process, Design Metrics and optimization of various parameters of embedded system. Embedded processor technology: IC technology, Design technology, Software development life cycle (SDLC) models like Waterfall, Spiral, V, Rapid Prototyping models and comparison.

Unit II: Structure of μ COS 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 μ COS II (07)

Critical Section, Shared resources, Inter task communication, Mutual exclusion, Semaphore Management: Creation/Deletion, Pending/Posting/Acceptance/Query, Mutual Exclusion Semaphores: Creation/Deletion, Pending/Posting/Acceptance/Query, Event Flag Management: Internals, Creation/ Deletion of Event Flag groups, Waiting/Setting/Clearing/Looking for/Querying an Event Flag Group.

Unit IV: Structure of μ COS 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 μ COS 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 μ COS-II: Development tools, Directories and Files, Configuration and testing of Port.

Unit VI: Linux Kernel Construction

(07)

Need of Linux, Embedded Linux Today, Open Source and the GPL, BIOS Versus Boot loader Linux Kernel Background, Linux Kernel Construction, Kernel Build System, Kernel Configuration, Role of a Bootloader, Bootloader Challenges, A Universal Bootloader: Das U-Boot, Porting U-Boot.

Text Books:

1. Jean J. Labrosse, “**MicroC OS II, The Real-Time Kernel**”, *CMP Books*, (2nd Edition), (2011).
2. Christopher Hallinan, “**Embedded Linux Primer - A Practical, Real-World Approach**”, *Prentice Hall Pvt.*, (2nd Edition), (2010).
3. Raj Kamal, “**Embedded Systems –Architecture, Programming and Design**”, *McGraw Hill*, (2nd Edition), (2008).

Reference Books:

1. Dr. K. V. K. K. Prasad “**Embedded / real time System: Concepts, Design, & Programming - Black Book**”, *Dreamtech Press Publication*, (2nd Edition), (2003).
2. Frank Vahid and Tony Givargis, “**Embedded System Design – A Unified hardware/ Software introduction**”, *Wiley Publication*, (3rd Edition), (2006).

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

In Semester: 50 Marks

End Semester: 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
To understand logic fault models and learn test generation for sequential and combinational
3. 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)

True paths, Transitions, Multi-cycle operations, Clock specification, Interface specification, Timing checks, Timing constraints, Design rule constraints, Wire-load model, Gate delay, Net delay, Timing reports, Back annotation, Delay Formats: Standard Delay Format (SDF).

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)

Introduction, Power Basic, Key Factors in Accurate Power Estimation, Power Estimation Early in the Design Cycle, Simulation Based Power Estimation, Best Practices for Power Estimation, Supply and ground bounce, Power distribution techniques, Power optimization, Clock Skew, Timing considerations, Hazards, Clock distribution, Clock jitter, Interconnect routing techniques.

Text Books:

1. J. Bhasker, Rakesh Chadha, “**Static Timing Analysis For Nano-meter Designs: A Practical Approach**”, *Springer*, (1st Edition), (2009).
2. Jan M. Rabaey, “**Digital Integrated Circuits Design Perspective**”, *Prentice Hall of India Pvt. Ltd.*, (2nd Edition), (2002).

Reference Books:

1. Srivastava Ashish, Sylvester Dennis, Blaau David, “**Statistical Analysis and Optimization for VLSI: Timing and Power**”, *Springer*, (1st Edition), (2005).
2. Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, “**VLSI Test Principles and Architectures: Design for Testability**”, *Elsevier*, (1st Edition), (2006).
3. M. L. Bushnell and V. D. Agrawal, “**Essential of Electronic Testing for Digital, Memory, and Mixed Signal VLSI Circuits**”, *Springer*, (1st Edition), (2005).

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)

Categories of Artificial Intelligence (AI), Applications of AI, Intelligent agents, Agents and environments, Good behavior, The nature of environments, Structure of agents. Applications of Artificial Intelligence, Game Playing, Expert Systems, Natural Language Processing, Image Understanding, Robotics, Pattern Recognition, Virtual Reality, Computer Vision, Intelligent Control

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, Propositional versus first order logic, Forward chaining, backward chaining, Resolution, Knowledge representation, Uncertainty and methods, Bayesian probability and Belief network.

Unit IV: Reasoning

(06)

Types of Reasoning, Non-monotonic Inference Methods Non-monotonic Reasoning, Truth Maintenance Systems, Reasoning with Fuzzy Logic, Fuzzy Sets, Fuzzy Reasoning, Rule-based Reasoning, Diagnosis Reasoning, Case-based Reasoning Systems, Model-based Reasoning Systems

Unit V: Learning (07)

Learning from observations: forms of learning, Inductive learning, Learning decision trees, Ensemble learning, Knowledge in learning, Logical formulation of learning, Explanation based learning, Learning using relevant information, Statistical learning, Hidden Markov Models, Association Learning: Apriori Algorithm, Eclat Algorithm, Fuzzy Network, Fuzzy Systems, Info Fuzzy Networks, Fuzzy Neural Systems

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.

Ethics of AI : Privacy and Surveillance, Manipulation of Behavior, Opacity of AI Systems, Bias in Decision Systems, Human-Robot Interaction, Automation and Employment, Autonomous Systems, Machine Ethics, Artificial Moral Agents Privacy

Text Books:

1. Vinod Chandra S. S., Anand Hareendran S., “**Artificial Intelligence and Machine learning**”, *PHI*, (1st Edition) (2014).
2. Stuart Russell, Peter Norvig, “**Artificial Intelligence**”, *A Modern Approach* ', *Pearson Education/Prentice Hall of India*, (3rd Edition), (2010).
3. Elaine Rich, Kevin Knight and Shivshankar Nair, “**Artificial Intelligence**”, *Tata McGraw Hill*, (3rd Edition), (2009).
4. Paula Boddington, “**Towards a Code of Ethics for Artificial Intelligence**”, *Springer international Publishing*, (1st Edition), (2017).

Reference Books:

1. Nils J. Nilsson, “**Artificial Intelligence: A new Synthesis**”, *Morgan Kaufmann Publishers*, (1st Edition), (1998).
2. George F. Luger, “**Artificial Intelligence: Structures and Strategies for Complex Problem Solving**”, *Pearson Education*, (6th Edition), (2008).

Online Resources:

1. NPTEL Course “**Artificial Intelligence**”
<http://nptel.ac.in/courses/106105077/>
2. <https://plato.stanford.edu/entries/ethics-ai/>
3. <https://intelligence.org/files/EthicsofAI.pdf>
4. [https://www.europarl.europa.eu/RegData/etudes/STUD/2020/634452/EPRS_STU\(2020\)63445_2_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2020/634452/EPRS_STU(2020)63445_2_EN.pdf)

20PEEC 802C STATISTICAL SIGNAL PROCESSING

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 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)

Wiener Hoff Equation, Causal and Non Causal FIR filter, Linear Prediction using FIR Filter, Lattice representation of FIR filter, Causal IIR Wiener filter, Application of Wiener Filter as Noise Canceller.

Unit IV: Adaptive Filtering (10)

Principle and Applications, Steepest Descent Algorithm Convergence characteristics, LMS algorithm, Convergence, Excess mean square error, Leaky LMS algorithm, Application of Adaptive filters, Kalman filtering: State-space model and the optimal state estimation problem, Discrete Kalman filter, Extended Kalman filter.

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:

1. Charles W. Therrien, “**Discrete Random Signals and Statistical Signal Processing**”, *Prentice Hall Signal Processing Series*, (1st Edition), (2004).
2. Monson H. Hayes, “**Statistical Digital Signal Processing and Modeling**”, *John Wiley and Sons, Inc, Singapore*, (1st Edition), (2002).

Reference Books:

1. Simon Haykin, “**Adaptive Filter Theory**”, *Prentice Hall*, (5th Edition), (2013).
2. J. G. Proakis, “**Algorithms for Statistical Signal Processing**”, *Pearson Education*, (1st Edition), (2002).

Online Resources:

1. NPTEL Course “**Statistical Signal Processing**”
<https://nptel.ac.in/courses/108/103/108103158/>

20PEEC 802D MOBILE COMMUNICATION

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 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)

Basics of spread spectrum, Orthogonal codes, Physical and logical channels of IS-95, Handover mechanism, Factors affecting the performance of CDMA system, Comparison of WCDMA and CDMA 2000, Overview of LTE Standard, Architecture and Frame structure of LTE, Introduction to 5G standard, Comparison between 4G and 5G.

Text Books:

1. Theodore S Rappaport, **“Wireless Communications Principles and Practice”**, *Pearson Education*, (2nd Edition), (2010).
2. Andrea Goldsmith, **“Wireless Communications”**, *Cambridge University Press*, (1st Edition), (2005).
3. William C.Y. Lee, **“Mobile Communications Engineering: Theory and applications”**, *McGraw-Hill Education*, (2nd Edition), (2017).

Reference Books:

1. Vijay K. Garg, Joseph E. Wilkes, **“Principles and Applications of GSM”**, *Pearson Education*, (6th Edition), (2009).
2. Vijay K. Garg, **“IS-95 CDMA and CDMA 2000 Cellular/PCS Systems Implementation”**, *Pearson Education*, (1st Edition), (2000).
3. R. Blake, **“Wireless Communication Technology”**, *Thomson Delmar*, (1st Edition), (2015).

Online Resources:

1. NPTEL Course on **“Introduction to wireless and cellular communication”**
https://onlinecourses.nptel.ac.in/noc20_ee61/

20OE801B CYBER PHYSICAL SYSTEM

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 50 Marks

Credits: 3

Prerequisite: 20EC404 Embedded System, 20EC603 Control Systems

Course Objectives:

1. To introduce modeling of the Cyber Physical System (CPS).
2. To analyze the CPS.
3. To explain the software modules.

Course Outcomes:

After completion of the course, students will be able to

1. Categorize the essential modeling formalism of CPS
2. Analyze the functional behavior of CPS based on standard modeling formalisms
3. Apply specific software for the CPS using existing synthesis tools
4. Design CPS requirements based on operating system and hardware architecture constraints

Unit I: Cyber Physical Systems (CPS) applications and Characteristics (07)

CPS in the real world, Basic principles of design and validation of CPS, CPS: From features to software components, Mapping software components to Electronic Control Unit (ECU), CPS Performance Analysis: effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion, Formal methods for Safety Assurance of CPS.

Unit II: CPS physical systems modeling (07)

Stability Analysis: CLF (Common Lyapunov function), MLF (Multiple Lyapunov function), stability under slow switching, Performance under Packet drop and Noise.

Unit III: CPS computer systems modeling (07)

CPS SW Verification: Frama-C, C Bounded Model Checker (CBMC), Secure Deployment of CPS: Attack models, Secure Task mapping and Partitioning, State estimation for attack detection, Hybrid Automata Modelling: Flow pipe construction using Flowstar (Flow*), Polyhedral Hybrid Automaton Verifier (Phaver) tools (Reliability testing).

Unit IV: Operating systems and hardware architecture support for CPS (07)

CPS SW stack RTOS, Scheduling Real Time control tasks. Principles of Automated Control Design: Dynamical Systems and Stability, Controller Design Techniques, CPS HW platforms: Processors, Sensors, Actuators, CPS Network.

Unit V: Analysis and verification of CPS (07)

Advanced Automata based modeling and analysis: Basic introduction and examples, Timed and Hybrid Automata, Definition of trajectories, Formal Analysis: Flow pipe construction, Reachability analysis, Analysis of CPS Software, Weakest Preconditions, Bounded Model checking.

Unit VI: CPS case studies (07)

Automotive Case study: Vehicle ABS hacking, Power Distribution Case study: Attacks on Smart grid.

Text Books:

1. Lee, Edward Ashford, and Sanjit Arunkumar Seshia, “**Introduction to embedded systems: A cyber physical systems approach**”, MIT Press, (2nd Edition), (2017).
2. Rajeev Alur, “**Principles of Cyber-Physical Systems**”. *MIT Press*, (1st Edition), (2015).
3. Wolf, Marilyn, “**High-Performance Embedded Computing: Applications in Cyber-Physical Systems and Mobile Computing**”. *Elsevier*, (1st Edition), (2014).

Reference Books:

1. P. Tabuada, “**Verification and control of hybrid systems: a symbolic approach**”, Springer-Verlag, (1st Edition), (2009).
2. Raj Rajkumar, Dionisio De Niz , and Mark Klein, “**Cyber-Physical Systems**”, *SEI Series in Software Engineering*, (1st Edition), (2018).
3. André Platzer, “**Logical Analysis of Hybrid Systems: Proving Theorems for Complex Dynamics**”, *Springer*, (1st Edition), (2010).
4. Jean J. Labrosse, “**Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C**”, *CRC Press*, (2nd edition), (2011).

Online Resources:

1. Coursera course, **Cyber Physical system modelling**
<https://www.coursera.org/learn/cyber-physical-systems>

20OE801H QUANTUM COMPUTING

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 50 Marks

Credits: 3

Prerequisite: 20BS04 Physics, 20BS01 Linear Algebra & Univariate Calculus, 20BS03 Multivariate Calculus

Course Objectives:

1. To give an introduction to quantum computation
2. To explain the basics of quantum mechanics
3. To analyze quantum circuits using qubit gates
4. To elaborate difference between classical and quantum information theory
5. To explain quantum algorithms
6. To explain noise and error correction

Course Outcomes:

After completion of the course, students will be able to

- CO1. Describe the basics of quantum computation
- CO2. Apply the concepts of quantum mechanics
- CO3. Design of quantum circuits using qubit gates
- CO4. Comparison between classical and quantum information theory
- CO5. Utilize quantum algorithms
- CO6. Apply noise and quantum error correction

Unit I: Introduction to Quantum Computation (03)

Quantum bits, Bloch sphere representation of a qubit, multiple qubits.

Unit II: Background Mathematics and Physics (08)

Hilbert space, Probabilities and measurements, Entanglement, Density operators and correlation, Basics of quantum mechanics, Measurements in bases other than computational basis.

Unit III: Quantum Circuits (08)

Single qubit gates, Multiple qubit gates, Design of quantum circuits.

Unit IV: Quantum Information and Cryptography (08)

Comparison between classical and quantum information theory, Bell states, Quantum teleportation, Quantum Cryptography, No cloning theorem.

Unit V: Quantum Algorithms (07)

Classical computation on quantum computers, Relationship between quantum and classical complexity classes, Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search.

Unit VI: Noise and error correction (08)

Graph states and codes, Quantum error correction, fault-tolerant computation.

Text Books:

1. Michael Nielsen and Isaac Chuang, **“Quantum Computation and Quantum Information”**, *Cambridge University Press, UK*, (10th Edition), (2012).
2. Phillip Kaye, Raymond Laflamme and Michele Mosca, **“An Introduction to Quantum Computing”**, *Oxford University Press, UK*, (1st Edition), (2007).

Reference Books:

1. N. David Mermin, **“Quantum Computer Science An Introduction”**, *Cambridge University Press, UK*, (1st Edition), (2007).
2. Noson Yanofsky and Mirco Manna, **“Quantum Computing for Computer Scientists”**, *Cambridge University Press*, (1st edition), (2008).

Online Resources:

1. NPTEL Course **“Quantum Computing”**
https://onlinecourses.nptel.ac.in/noc19_cy31/

200E802C AUTONOMOUS ROBOTS

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 50 Marks

Credits: 3

Prerequisite: 20BS01 Linear Algebra and Univariate Calculus, 20ES01: Basic Electrical and Electronics Engineering

Course Objectives:

1. To explain fundamentals of robotic system
2. To introduce kinematics, dynamics and control for robotics systems
3. To introduce trajectory planning for motion
4. To describe application of robots in automation

Course Outcomes:

After completion of the course, students will be able to

- CO1 Explain and classify different components used in developing autonomous robot
- CO2 Select sensors, actuators and grippers for autonomous robot
- CO3 Apply formulations to obtain kinematics, dynamics and trajectory planning of autonomous robot
- CO4 Develop path planning and navigation algorithm for autonomous robot
- CO5 Design robot for automation

Unit I: Introduction to Robotics (10)

Definition of robotics, Types of robots, Components of Robot system, Classification of robots, Robot architecture, Robot locomotion, Specification of robot, Robot sensors for position, Acceleration sensors, Proximity, Velocity sensors, Force sensors, Tactile sensor, Camera and robot vision, Actuators and end effectors.

Unit II: Introduction to Mechanics of Robotic Arm (10)

Position and orientation description, Coordinate transforms, Homogeneous transform, Denavit and Hartenberg (DH) parameters, Forward and inverse kinematic analysis, Dynamics and inverse Dynamics of robots, Newton–Euler formulation, Trajectory and Path planning, Application of robotic arm.

Unit III: Mobile robot Kinematics and Dynamics (08)

Forward and inverse kinematics, holonomic and nonholonomic constraints, Kinematic models of simple car and legged robots, Dynamic simulation of mobile robots.

Unit IV: Localization (06)

Odometric position estimation, Belief representation, Probabilistic mapping, Markov localization, Bayesian localization, Kalman localization, Positioning beacon systems.

Unit V: Introduction to Planning and Navigation (08)

Path planning algorithms based on Simultaneous Localization and Mapping (SLAM) algorithm, A-star, D-star, Voronoi diagrams, Probabilistic Road Maps (PRM), Rapidly exploring Random Trees (RRT), Markov Decision Processes (MDP), Stochastic Dynamic Programming (SDP).

Text Books:

1. R. Siegwart, I. R. Nourbakhsh, “**Introduction to Autonomous Mobile Robots**”, *The MIT Press*, (2nd Edition), (2011).
2. Francis X. Govers, “**Artificial Intelligence for Robotics**”, *Packt Publishing Ltd., United Kingdom*, (1st Edition), (2018).
3. Robin R. Murphy, “**Introduction to Artificial Intelligence for Robotics**”, *The MIT Press*, (2nd Edition), (2000).
4. S. K. Saha, “**Introduction to Robotics**”, *Tata McGraw Hill*, (2nd Edition), (2014).

Reference Books:

1. K. S. Fu, R. C. Gonzalez, C. S. G. Lee, “**Robotics Control, Sensing, Vision and Intelligence**”, *Tata McGraw Hill*, (2nd Edition), (2008).
2. Robert J. Schilling, “**Fundamentals of Robotics- Analysis and Control**”, *Prentices Hall India*, (1st Edition), (2008).

Online Resources:

1. NPTEL Course “**Wheeled Mobile Robot**”
<https://nptel.ac.in/courses/112/106/112106298/>

200E802I Wireless Networks

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 50 Marks

Prerequisite: Nil

Course Objectives:

1. To explain the importance of wireless communication and multiple access techniques
2. To elaborate the behavior of communication system for indoor and outdoor wireless networks
3. To introduce 3G, 4G cellular network components and 5G future wireless network
4. To explain MIMO technology
5. To introduce visible light communications

Course Outcomes:

After completion of the course, students will be able to

- CO1 Explain fundamentals of wireless communication and multiple access techniques
- CO2 Analyze the behavior of communication system for indoor and outdoor wireless networks
- CO3 Apply 3G, 4G cellular network standards and describe 5G future wireless network
- CO4 Interpret MIMO technology its advantages and limitations
- CO5 Explain LiFi networking and technology for indoor network access

Unit I: Introduction to wireless communication (08)

Fundamentals of Wireless Communication: Advantages, Limitations and Applications, Frequency Spectrum, Radio and Infrared Frequency Spectrum, Wireless Media, Spread spectrum, Multiple access technique: TDMA, CDMA, FDMA, CSMA, OFDMA.

Unit II: Wireless indoor and outdoor networks (08)

WLAN, WiFi, Bluetooth, Zigbee, Ultra Wideband communication, Infrared, UHF narrowband, WiMax, Limitation of indoor networks.

Unit III: Cellular Network (08)

Spectrum reuse and re-framing, Cell cluster concept, Co-channel and adjacent channel interference, Cell site, call blocking and delay, Channel allocation strategies, 3G and 4G standard.

Unit IV: Future Wireless networks (10)

Introduction to 5G, Modulation techniques for 5G, Architecture, MIMO, Massive MIMO, Limitations and applications.

Unit V: Visible Light Communications (08)

LiFi Technology, LiFi Networking, LiFi technology for indoor network access, Applications.

Text Books:

1. T. Rappaport, “**Wireless Communications - Principles and Practice**”, *Prentice Hall* , (2ndEdition) , (2011).

2. Vijay Garg, “**Wireless Communications and networking**”, *Elsevier*, (1st Edition), (2007).
3. Jonathan Rodriguez, “**Fundamentals of 5G Mobile Networks**”, *Wiley*, (1st Edition),(2015).
4. Mohamed Gado, Doaa Abd El-Moghith, “**Li-Fi Technology for Indoor Access**”, *LAMBERT Academic Publishing*, (1st Edition), (2015).

Reference Books:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, “**3G Evolution HSPA and LTE for Mobile Broadband**”, *Academic Press*, (2nd Edition) , (2008).
2. Anurag Kumar, D.Manjunath, Joy kuri, “**Wireless Networking**”, *Elsevier*, (1st Edition), (2011).
3. Simon Haykin, Michael Moher, David Koilpillai, “**Modern Wireless Communications**”, *Pearson Education* , (1st Edition), (2013)
4. Aditya K. Jagannatham, “**Principles of Modern Wireless Communications Systems**”, *McGraw Hill Education (India) Private Limited*, (1st Edition), (2016).

Online Resources:

1. NPTEL Course on “**Introduction to Wireless and Cellular Communications**”,
<https://nptel.ac.in/courses/108/106/106106167/#>
2. NPTEL Course on “**Advanced 3G and 4G Wireless Mobile Communications**”,
<https://nptel.ac.in/courses/117/104/117104099/>

20EC801 BROADBAND COMMUNICATION SYSTEMS

Teaching Scheme

Lectures: 3 Hours / Week

Examination Scheme

In Semester: 50 Marks

End Semester: 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 wave
2. 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)

Electromagnetic Spectrum and Optical spectral bands, Key elements of fiber optic communications system, Ray theory of propagation: Fiber types, Transmission characteristics of optical fibers, Intra modal Dispersion, Intermodal dispersion. Introduction to optical sources: Wavelength and Material Considerations, LEDs and semiconductor LASERS: principle of working and their Characteristics, Material Considerations, PIN, Avalanche photodiodes.

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)

Architectural choices of next generation transport networks, Designing transmission layer using-SDM, TDM, WDM, Unidirectional versus Bidirectional WDM systems, SONET Layering, Frame Structure, Physical network topologies, Access Networks- PON, Optical Interconnects, Data Centers ,Optical communication for Wireless Fronthauling.

Unit IV: WDM Network Design (07)

Cost Trade-Offs: A Detailed Ring Network, Light path Topology Design, Routing and Wavelength Assignment(RWA), Wavelength Conversion, Dimensioning Wavelength-Routing Networks, Online RWA in Rings, Long Haul Network case study, Metro Ring Network Case study.

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)

Overview of satellite communication, New Services and Applications, Traffic Modeling and Characterization, IPv6 Networks over Satellites, Future Development of Satellite Networking.

Text Books:

1. Gerd Keiser, "**Optical Fiber Communications**", *Tata McGraw Hill*, (5th Edition), (2013).
2. John M. Senior, "**Optical Fiber Communications: Principles and Practice**", *PHI*, (3rd Edition), (2008).
3. Anthony S. Acampora, "**An Introduction to Broadband Networks LANs, MANs, ATM, B-ISDN, and Optical Networks for Integrated Multimedia**", *Springer US* (1st Edition), (1994).
4. Rajiv Ramaswami, Kumar N. Sivarajan, and Galen H. Sasaki, "**Optical Networks: A Practical Perspective**", *Morgan Kaufmann Publishers Inc*, (3rd Edition), (2010).
5. C. Siva Ram Murthy and Mohan Guruswamy, "**WDM Optical Networks: Concepts, Design and Algorithms**", *PHI*, (1st Edition), (2001).
6. Zhili Sun, "**Satellite Networking Principles and Protocols**", *John Wiley & Son*, (2nd Edition), (2014).

Reference Books:

1. Djafar K. Mynbaev and Lowell L. Scheiner, "**Fiber Optic Communications Technology**", *Pearson Education*, (1st Edition), (2000).
2. Govind P. Agrawal, "**Fiber Optic Communication Systems**", *Wiley India*, (3rd Edition), (2002).
3. Dennis Roddy, "**Satellite Communications**", *McGraw Hill*, (4th Edition), (2017).

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/>

20PEEC 801LA MICROWAVE AND RADAR ENGINEERING LAB

Teaching Scheme

Lectures: 2 Hours / Week

Examination Scheme

In Semester: 25 Marks

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.
4. To learn the nature of standing waves formed due to impedance mismatch.
5. 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 TE₁₀ 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

In Semester: 25 Marks

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

In semester: 25 Marks

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 AND RTOS LAB

Teaching Scheme

Practical: 2 Hours / Week

Examination Scheme

In Semester: 25 Marks

Practical: 25 Marks

Credits: 1

Course Objectives:

1. Interface real world input and output devices
2. Discuss use of μ COS-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 μ COS-II RTOS on ARM7.
2. Multitasking in μ COS-II RTOS using min 4 tasks on ARM 7
3. Semaphore as Signaling and Synchronizing on ARM 7.
4. Mailbox implementation for message passing on ARM 7.
5. Implement MUTEX on ARM 7.
6. Use OS service(s) to accept keyboard input and display/transmit.
7. Building tool chain for embedded Linux and porting Kernel on ARM 9 target board.
8. Write a program 'Hello world; using embedded Linux on ARM 9.