Bansilal Ramnath Agarwal Charitable Trust’s

Vishwakarma Institute of Technology
(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Structure & Syllabus of
T. Y. B. Tech.
(Electronics & Telecommunication Engineering)
Pattern ‘C-19’
Academic Year 2019-20

Prepared by: - Board of Studies in E&TC Engineering
Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune

Signed by

Chairman – BOS

Chairman – Academic Board
Institute Vision:
To be a globally acclaimed Institute in Technical Education and Research for holistic Socio-economical development

Institute Mission:
- To impart knowledge and skill based Education in Collaboration with Industry, Academia and Research Organizations.
- To strengthen global collaborations for Students, Faculty Exchange and joint Research
- To prepare competent Engineers with a spirit of Entrepreneurship
- To Inculcate and Strengthen Research Aptitude amongst the Students and Faculty

Department Vision:
To be a center of Academic Excellence in Electronics, Telecommunication and Related Domains through Continuous Learning and Innovation.

Department Mission:
- To provide state of art education in Electronics and Telecommunication Engineering to meet current and future needs of society, industry and academia.
- To strengthen collaborations with industries and institutes of repute to foster research culture among faculty members and students.
- To promote ethically conscious engineers demonstrating sustainable entrepreneurship and professional maturity in social context.

Program Educational Objectives (PEOs):
Graduates of the program will
- Have comprehensive knowledge of Electronics engineering fundamentals to face the challenges of real life complex problems
- Be professionals imbibed with a spirit of leadership, ethical behavior and societal commitment
- Be compliant to constantly evolving technology through lifelong learning

Program Outcomes:
Engineering Graduates will be able to:
1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and
environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**Program Specific Objectives (PSOs)**
E&TC Graduates will have Ability to:


2. Identify and Apply domain specific hardware and software tools to solve real-world problems in Electronics and Communication.
<table>
<thead>
<tr>
<th>Sr. No</th>
<th>CONTENTS</th>
<th>Structure</th>
<th>Page No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Semester I Syllabi</strong></td>
<td>5-6</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Real Time Embedded Systems</td>
<td>ET3001</td>
<td>9</td>
</tr>
<tr>
<td>1.2</td>
<td>Power Electronics</td>
<td>ET3003</td>
<td>11</td>
</tr>
<tr>
<td>1.3</td>
<td>VLSI Design</td>
<td>ET3005</td>
<td>13</td>
</tr>
<tr>
<td>1.4</td>
<td>Information Theory and Coding Techniques</td>
<td>ET3007</td>
<td>15</td>
</tr>
<tr>
<td>1.5</td>
<td>Data Communication and Networking</td>
<td>ET3009</td>
<td>17</td>
</tr>
<tr>
<td>1.6</td>
<td>Digital Signal Processing</td>
<td>ET3002</td>
<td>19</td>
</tr>
<tr>
<td>1.7</td>
<td>Analog Circuits</td>
<td>ET3115</td>
<td>21</td>
</tr>
<tr>
<td>1.8</td>
<td>Advances in Digital Communication</td>
<td>ET3034</td>
<td>24</td>
</tr>
<tr>
<td>1.9</td>
<td>Engineering Design &amp; Innovation 1</td>
<td>ET3027</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td><strong>Semester II Syllabi</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Digital Image Processing</td>
<td>ET3021</td>
<td>26</td>
</tr>
<tr>
<td>2.2</td>
<td>Robotics</td>
<td>ET3004</td>
<td>28</td>
</tr>
<tr>
<td>2.3</td>
<td>Digital Design</td>
<td>ET3006</td>
<td>30</td>
</tr>
<tr>
<td>2.4</td>
<td>Antenna and Microwave Theory</td>
<td>ET3008</td>
<td>32</td>
</tr>
<tr>
<td>2.5</td>
<td>Machine Learning and Computer Vision</td>
<td>ET3012</td>
<td>35</td>
</tr>
<tr>
<td>2.6</td>
<td>Object Oriented Programming</td>
<td>ET3024</td>
<td>37</td>
</tr>
<tr>
<td>2.7</td>
<td>Database Management Systems</td>
<td>ET3025</td>
<td>39</td>
</tr>
<tr>
<td>2.8</td>
<td>Biomedical Electronics</td>
<td>ET3010</td>
<td>41</td>
</tr>
<tr>
<td>2.9</td>
<td>Wireless Communication</td>
<td>ET3014</td>
<td>44</td>
</tr>
<tr>
<td>2.10</td>
<td>Sensors and Internet of Things</td>
<td>ET3016</td>
<td>46</td>
</tr>
<tr>
<td>2.11</td>
<td>Engineering Design &amp; Innovation 2</td>
<td>ET3028</td>
<td>-</td>
</tr>
<tr>
<td>2.12</td>
<td><strong>General Profeciency 3</strong></td>
<td>ET3033</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(***) Audit Course evaluated in second semester</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Title: Course Structure

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Teaching Scheme (Hrs/Week)</th>
<th>Examination scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ISA</td>
<td>ESA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Theory</td>
<td>Lab</td>
</tr>
<tr>
<td>S1</td>
<td>ET3001</td>
<td>Real Time Embedded Systems</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>S1</td>
<td>ET3003</td>
<td>Power Electronics</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>S2</td>
<td>ET3005</td>
<td>VLSI Design</td>
<td>3</td>
<td>2</td>
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<tr>
<td>S2</td>
<td>ET3007</td>
<td>Information Theory and Coding Techniques</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>S3</td>
<td>ET3009</td>
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<td>3</td>
<td>2</td>
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<td>ET3002</td>
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<td>3</td>
<td>2</td>
</tr>
<tr>
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<td>3</td>
<td>2</td>
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<td>ET3034</td>
<td>Advances in Digital Communication</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>S5</td>
<td>ET3027</td>
<td>Engineering Design &amp; Innovation 1</td>
<td>2</td>
<td>4</td>
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Total: 20
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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISA</td>
<td>In Semester Assessment</td>
</tr>
<tr>
<td>HA</td>
<td>Home Assignment</td>
</tr>
<tr>
<td>MSE</td>
<td>Mid Semester Examination</td>
</tr>
<tr>
<td>ESE</td>
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</tr>
<tr>
<td>ESA</td>
<td>End Semester Assessment</td>
</tr>
<tr>
<td>GD / PPT</td>
<td>Group Discussion / Power Point Presentation</td>
</tr>
<tr>
<td>Sr. No.</td>
<td>Subject Code</td>
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<td>ET3021</td>
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<td>ET3004</td>
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<td>S2</td>
<td>ET3006</td>
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<tr>
<td>S2</td>
<td>ET3008</td>
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<tr>
<td>S3</td>
<td>ET3012</td>
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<td>S3</td>
<td>ET3024</td>
</tr>
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<td>ET3025</td>
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<tr>
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<td>ET3010</td>
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<td>S4</td>
<td>ET3014</td>
</tr>
<tr>
<td>S4</td>
<td>ET3016</td>
</tr>
<tr>
<td>S5</td>
<td>ET3028</td>
</tr>
<tr>
<td>S6</td>
<td>ET3033</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
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</tr>
</tbody>
</table>

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ET3001: Real Time Embedded Systems

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Section 2:
Real-Time Operating System
Real-Time Tasks, Task Periodicity, Task Scheduling, Clock Driven Scheduling, Event Driven Scheduling, Resource Sharing, Commercial RTOS
Structure of µCOS – II
Kernel Structure, Task Management, Time Management, Semaphore Management, Event Flag Management, Message Mailbox Management, Message Queue Management, Memory Management, and Porting of µCOS II, Application Development

List of Practicals (Any Six):
1. Interfacing of LEDs
2. LCD & Keypad
3. ADC & DAC
4. UART
5. Task Scheduling for Input and Output Devices (4X4 Keyboard, 16X2 LCD display and ADC) using µCOS- II Semaphore

List of Projects (Any One):
1. Design of a Digital Display
2. Touch Screen Control Panel for Stepper Motor
3. Water Level Controller
4. Landmark Recognition
5. Control of 3 Devices using RS-485 Standard
6. Control of 3 Devices using CAN Protocol
7. Control of 3 Devices using Profibus
Text Books:
1. ARM Developers Guide, Sloss Andrew

Reference Books:
1. Embedded / Real Time Systems Programming Black Book, Dreamtech Press, Dr. K.V.K.K. Prasad
2. Embedded System Design – A Unified hardware.

Course Outcomes:
The student will be able to –
1. Comprehend architecture of ARM processor and its peripheral interfacing. (CO Attainment Level: 3)
2. Implement RS-485, CAN protocols. (CO Attainment Level: 4)
3. Understand approaches to solve hardware-software partitioning problems. (CO Attainment Level: 3)
4. Explain features and policies followed by a Real-Time Operating System. (CO Attainment Level: 3)
5. Explain Structure of UCOS-II. (CO Attainment Level: 3)
6. Apply concepts of system programming to develop real-time embedded system. (CO Attainment Level: 4)
ET3003: Power Electronics

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:
DC Drives: Controlled bridge rectifiers and its analysis, DC Motors starting, characteristic and speed control, DC drive requirements.
AC Voltage Controllers: Configurations and operation, Applications.

Section 2:
AC Drives: Single phase inverters – Working of push pull inverters, full bridge inverter with R and L load, Harmonic analysis of output voltage, Importance of PWM technique for voltage control
Induction motor- Starting, Characteristic and speed control, AC drive requirements.
Switched mode DC/DC Converters: Linear power supplies, switching power supplies without galvanic isolation- step down converters, step up converter, buck boost converter - continuous and discontinuous conduction. Switching dc power supplies with galvanic isolation - fly back converters, forward converters, push pull converters.
Applications: HF induction heating, RF heating, ON- line and OFF line UPS, battery selection and design considerations, Solar Photovoltaic (SPV) system.

List of Practicals (Any Six): (Any 6)
1. Driver circuit for SCR.
2. Single phase Half Controlled (Semi) converter
3. Single phase Fully Controlled (Full) converter
4. AC to AC Converter.
5. Single phase Bridge-inverter
6. MOSFET based PWM Chopper
7. Simulation of power electronic conversion system (AC-DC/ DC-DC), with suitable load.
8. Simulation of power electronic conversion system (DC-AC/AC-AC), with suitable load.
9. Study of SMPS
10. Study of UPS.

List of Projects (Any One):
1. Single phase Power Control (e.g. Fan speed regulator/ Lighting control)
2. Power Supply/Battery charger
3. DC motor speed control
4. Induction motor speed control
5. Emergency lighting system

Text Books:

Reference Books

Course Outcomes:
The student will be able to –
1. Select power device for given voltage- current specifications. (CO Attainment Level: 3)
2. Analyze DC Drives with controlled converter. (CO Attainment Level: 3)
3. Analyze AC to AC converters. (CO Attainment Level: 3)
4. Analyze AC Drives with inverter. (CO Attainment Level: 4)
5. Analyze, compare and select SMPS configuration. (CO Attainment Level: 3)
6. Select power converters for real life applications. (CO Attainment Level: 3)
ET3005: VLSI Design

Credits: 4

Teaching Scheme: 5 Hours / Week

Theory: 3 Hours / Week

Lab/ Project: 2 Hours / Week

Section 1:
MOSFET: Introduction to MOSFET, MOSFET Capacitor, IV Characteristics, Motivation for Scaling, Types of Scaling, Short channel Effect, Velocity saturation, Mobility degradation, Subthreshold current, Threshold voltage variation, Drain induced barrier lowering (DIBL), Drain punch through, Hot carrier effect, Surface states and interface trapped charge.
Combinational & Sequential Circuits, Semiconductor Memories: SRAM, DRAM cell, Access Time Consideration, ROMs
CMOS Fabrication & Layout: Inverter Cross-section, Fabrication Process – Twin well / Tub Technology, Silicon on Insulator (SOI), N-well / P-well Technology, Layout Design Rules, Gate layouts, Stick Diagrams, CMOS Inverter, CMOS logic Gates, Compound Gates.

Section 2:
Propagation Delay in CMOS: CMOS Region of operation, Beta-n by beta-p ratio, Pseudo NMOS Inverter (Cascade pseudo NMOS, Saturated pseudo NMOS, Dependence of Propagation delay on Fan-in and Fan-out, RC-Delay, Elmore delay, Parasitic delay, Logical Effort – Basic logic circuits and multistage logic networks
Power Dissipation in CMOS: Effect of power dissipation, Temperature, Dynamic power dissipation - Activity Factor, Capacitance, Voltage, Frequency, Short-Circuit current; Static Power dissipation, multiple threshold voltages and oxide thicknesses, variable threshold voltages, input vectors control; Energy Delay optimization, Low Power CMOS logic circuits

List of Practicals (Any Six):
1. 2:4 Decoder
2. 3:2 priority encoder
3. 4 - bit adder
4. JK flip-flop
5. DRAM Cell
6. SRAM

List of Projects (Any One):
1. Design static CMOS circuit to realize FIFO / LIFO
2. Design static CMOS circuit to compute \( F = (A+B)(C+D) \). Choose transistor sizes to achieve least delay and estimate this delay in \( T \).
3. A static CMOS NOR gate uses four transistors, while a pseudo-nMOS NOR gate uses only three. Unfortunately, the pseudo-nMOS output does not swing rail to rail. If both the inputs and their complements are available, it is possible to build a 3-transistor NOR that swings rail to rail without using any dynamic nodes. Show how to do it.
4. Sketch a 3-input symmetric NOR gate. Size the inverters so that the pulldown is four times as strong as the net worst-case pullup. Label the transistor widths. Estimate the rising, falling, and average logical efforts.

Text Books:

Reference Books:

Course Outcomes:
The student will be able to –
1. Determine MOSFET behavior under dimension scaling. (CO Attainment Level: 3)
2. Design CMOS based logic circuit. (CO Attainment Level: 3)
3. Demonstrate understanding of CMOS fabrication flow. (CO Attainment Level: 2)
4. Analyze delays in CMOS circuits. (CO Attainment Level: 4)
5. Understand power dissipation in CMOS circuits. (CO Attainment Level: 4)
6. Analyze clock signal variations and timing issues. (CO Attainment Level: 5)
ET3007: Information Theory & Coding Techniques

Credits: 4
Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:
Introduction to Information theory, Discrete memory less channel, Entropy and its properties, Differential entropy and mutual Information, Information Capacity theorem.
Kraft’s McMillan Inequality, Source coding theorem, Huffman coding, Shannon-Fano coding, Arithmetic Coding, Dictionary Techniques for lossless compression, Linear Block Codes- Syndrome and error detection, Error detection and correction capacity, Standard array and syndrome decoding, Encoding and decoding circuit, Single parity check codes

Section 2:
Cyclic Codes, generator polynomial, Generator matrix for systematic cyclic code, Encoding for cyclic code, Syndrome decoding of cyclic codes, Convolutional Codes, State diagram, Polynomial description of convolution code; Generator matrix of convolution code, Tree diagram, Trellis diagram, Viterbi decoding, Binary BCH code, Generator polynomial for BCH code, Decoding of BCH code, RS codes, generator polynomial for RS code, Decoding of RS codes.

List of Practicals (Any Six):
1. To determine Entropy and information rate for the given source.
2. To implement Huffman code.
3. To implement arithmetic code.
4. To implement LZ77 algorithm.
5. To implement LZW algorithm.
6. To implement LZ77 algorithm
7. To implement linear block codes.
8. To implement cyclic code.
9. To implement convolution code.
10. To implement Viterbi decoder

List of Projects (Any One):
1. Signal/Image compression with lossless/lossy compression techniques.
2. Text files compression with dictionary techniques.
3. Comparison of various channel coding Techniques.

Text Books:

Reference Books:
3. “Introduction to Data compression”, Khalid Sayood; Morgan Kaufmann Publisher.

Course Outcomes:
The student will be able to –
1. Evaluate the performance of source coding theorem based on entropy. (CO Attainment Level: 2)
2. Analyze & implement lossless compression techniques. (CO Attainment Level: 2)
3. Analyze linear block codes for error detection. (CO Attainment Level: 2)
4. Decode cyclic code for error detection. (CO Attainment Level: 2)
5. Generate Convolutional code & decode using Viterbi decoding. (CO Attainment Level: 3)
6. Analyze RS code. (CO Attainment Level: 3)
ET3009: Data communication and Networking

Credits: 4  
Teaching Scheme: 5 Hours / Week  
Theory: 3 Hours / Week  
Lab/ Project: 2 Hours / Week

Section 1:
Network Architecture and OSI reference model
Introduction to Computer Networks, Topologies, Types of Networks, Layered Architecture of Computer Networks, OSI reference model, functions of each layer
Channel and MAC, Types of Channels, Signaling methods, Channel accessing methods, Error control and Flow control.

Section 2:
LAN and WAN
Introduction to Local Area Networks, IEEE Standards for LANs, Wired LANs, Wireless LANs: IEEE 802.11, Channel Access Methods, Fast Ethernet, Gigabit Ethernet.
SONET/SDH, Frame Relay, ATM, Wireless WANs
Network Management and Security
Network Management System, Network Management protocols, Network Security
Network applications and protocols
File transfer protocol, E-mail and the Web, multimedia applications such as IP telephony and video streaming- Overlay networks like peer-to-peer file sharing and content distribution networks- Web Services architectures for developing new application protocols.

List of Practicals (Any Six):
1. Prepare and test a straight through and crossover cable.
2. Implement a LAN for file/printer sharing
3. Implement Sliding window protocol
4. Implement Error correction and checking methods.
5. Design a client server environment to implement a web application.
6. Design a client server environment to implement a File transfer application.
7. Implement substitution and transposition algorithms
8. Implement a RSA algorithm
9. Implement a network and study for routing
10. Implement a network and study for addressing mechanism.

List of Projects (Any One):
1. Implementation of flow control protocols
2. Implementation of ARQ protocols
3. Design of a LAN for given conditions
4. Design of WAN for given condition
5. Implement a network and debug using network tools.

Text Books:
1. Computer Networks (3rd edition), Tanenbaum Andrew S., International edition,

Reference Books:
1. Data and computer communication by William Stallings.

Course Outcomes:
The student will be able to-
1. Describe OSI reference Model. (CO Attainment Level: 1)
2. Design physical and data link layer functions and protocols of OSI model. (CO Attainment Level: 2)
3. Analyze the TCP/IP Protocol Suite. (CO Attainment Level: 3)
4. Design Local Area Networks and Wide Area Networks. (CO Attainment Level: 3)
5. Describe management functions and security algorithms. (CO Attainment Level: 2)
6. Develop application layer protocols. (CO Attainment Level: 4)
ET3002: Digital Signal Processing

Credits: 4
Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:
Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing. Discrete Fourier transform, DFT properties, computation of linear convolution using circular convolution, Linear filtering using overlap add and overlap save method, FFT algorithms, decimation in time and decimation in frequency using Radix-2 FFT algorithm, Goertzel algorithm, Z transform, relation between Laplace transform and Z transform, relation between Fourier transform and Z transform, properties of Z transform, relation between pole locations and time domain behavior, causality and stability considerations for LTI systems, Inverse Z transform.

Section 2:
Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, design of linear phase FIR filter using windows and frequency sampling method. FIR filters realization using direct form and cascade form. Finite word length effect in FIR filters design. Design of IIR filters from analog filters, Impulse invariant method, relationship between analog and digital frequencies, Bi-linear Transformation Method, comparison of Impulse-variance and Bi-linear Transformations, IIR filter specifications, Realization of IIR filters-Direct I and Direct II form structure, cascade structure, Parallel form structure. Introduction to lattice structure. Introduction to multirate signal processing: Interpolation, decimation, implementation of sampling rate conversion: polyphase filter structure.

List of Practicals (Any Six):
1. Perform discrete time signal analysis using FFT.
2. To perform linear convolution of two sequence using DFT.
3. To filter the long data sequence using overlap add/save algorithm.
4. To determine z-transform from the given transfer function and its ROC.
5. Test discrete time systems for stability and causality using Z-transform.
6. Implement different window functions and observe the effect of different windows on FIR filter response.
7. Design Butterworth filter (IIR) using bilinear transformation method and plot its frequency response.
8. To analyze coefficient quantization effects on the frequency response of an IIR filter.
9. Design sampling rate converter for given specification.
10. Design an appropriate filter to extract the information from noisy signal.

List of Projects (Any One):
1. ECG Signal Analysis
2. Speech Enhancement using Spectral Subtraction Method
3. Musical Instrument Identification
4. Audio Equalizer
5. Speech Recognition
6. DTMF Encoder and Decoder
7. Correcting the geometrical orientation of text in an image using discrete Fourier transform
8. Real time filtering using overlap-save or overlap-add method
9. Audio Effects Generation
10. Voice Activity Detector

Text Books:

Reference Books:

Course Outcomes:
The student will be able to –
1. Apply DFT to analyze discrete time signals. (CO Attainment Level: 2)
2. Compare computational complexity of DFT and FFT algorithm. (CO Attainment Level: 3)
3. Analyze LTI systems using Z-transform. (CO Attainment Level: 3)
4. Design linear phase FIR filter of given Specifications. (CO Attainment Level: 4)
5. Design IIR filter of given Specifications from equivalent analog filter. (CO Attainment Level: 4)
6. Implement sampling rate converter. (CO Attainment Level: 5)

ET3115: Analog Circuits

Credits: 4
Teaching Scheme: 5 Hours /
Week
Theory: 3 Hours / Week
Lab/Project: 2 Hours / Week

Section 1:
Feedback Amplifiers and Oscillators
Introduction to concept of feedback, Negative feedback, Topologies of feedback-voltage-series, current-series, voltage shunt and current shunt, Effect of feedback on gain, input impedance, output impedances & bandwidth of an amplifier, Analysis of feedback topology, positive feedback, oscillators, RC phase shift and Wien bridge oscillator.
Power Amplifiers
Classes of power amplifiers, Class A, Class B, Class AB, Class C and Class D amplifiers, Analysis of Class A, Class B, Class AB amplifiers, Distortion in amplifiers, Total Harmonic Distortion (THD), Comparison of power amplifiers
Fundamentals of Op-amp
Introduction to operational amplifier, block diagram, differential amplifier, current sources like constant I-source, I-mirror, Widlar current source, level shifters, op-amp configurations, ideal and practical op-amp, op-amp parameters like input offset voltage, output offset voltage, input offset current, input bias current, CMRR, slew rate, small signal and power bandwidth,

Section 2:
Linear Applications of op-amp
Summing amplifier, Difference amplifier, Voltage follower, Integrator, Differentiator, V-I converter, I-V converter, log amplifier, antilog amplifiers, temperature compensated log circuits, log ratio amplifier, Instrumentation amplifier.
Non-Linear Applications of op-amp
Comparators, Op-amp as comparator, Limitations of op-amp as comparator, Window comparator, Schmitt Trigger, Wave shaping circuits, Precision half wave and full wave rectifiers, peak detector, sample and hold circuit.
Waveform Generators
Astable, mono-stable and bi-stable multivibrators, waveform generators like sine, square, rectangular, pulse, triangular, saw tooth and ramp.

List of Practicals (Any Six):
1. Series Feedback Amplifier
2. Shunt Feedback Amplifier
3. Wien Bridge Oscillator
4. Op-amp Parameters
5. Design and testing of Integrator Circuit
6. Design and testing of Differentiator Circuit
7. Design and testing of V to I & I to V Converters
8. Design and testing of Schmitt Trigger circuit
9. Design and testing of Precision Half Wave and Full Wave Rectifier
10. Design and testing of Astable Multi-vibrator
11. Design and testing of Mono-stable Multi-vibrator
12. Design and testing of Waveform Generator

List of Projects (Any One):
1. Develop analog computer prototype
2. Water/Temperature level detector
3. Design and develop instrumentation amplifier
4. Applications of V-I Converters
5. Applications of I-V Converters
6. Applications of open loop/closed loop comparators
7. Develop function generator with specified parameters
8. Develop applications of Window comparator
9. Develop applications of Wave shaping Circuits
10. Develop triggering circuit
11. Develop audio control circuit
12. Develop absolute value Circuits

Text Books

Reference Books
2. Coughlin and Discroll,’operational amplifiers and linear integrated circuits,’ 6th Edition, PHI.
Course Outcomes
The students will be able to

1. Illustrate fundamentals of op-amp in terms of block diagram. (CO Attainment Level: 3)
2. Apply knowledge about parameters in practical applications. (CO Attainment Level: 2)
3. Design linear applications of op-amp. (CO Attainment Level: 3)
4. Design non-linear applications of op-amp. (CO Attainment Level: 3)
5. Develop function generator circuits. (CO Attainment Level: 3)
6. Design phase locked loop applications. (CO Attainment Level: 4)
ET3034: Advances in Digital Communication

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:
Linear modulation Techniques: Binary phase shift keying, Quadrature phase shift keying, \( \pi/4 \) QPSK, \( \pi/4 \) DQPSK, QAM.
Nonlinear modulation techniques: Continuous phase modulation-Minimum shift keying, Gaussian-filtered MSK.
Mathematical representation of noise, noise calculations, Impact of noise on Pulse code modulation and delta modulation, Probability of error for modulation techniques.

Section 2:
Channel Equalization: Fundamentals of equalization, Linear and Non Linear Equalization Techniques, Adaptive equalizer
Multiple Access Techniques: Time Division Multiple Access, Frequency Division Multiple Access, Code Division Multiple Access, Orthogonal Frequency Division Multiple Access.

List of Practicals:
Implementation of
1. Quadrature phase shift keying
2. \( \pi/4 \) shifted Quadrature phase shift keying.
3. Pseudo noise sequence generation.
4. Direct sequence spread spectrum with coherent Binary phase shift keying.
5. Zero forcing equalizer
6. Code Division Multiple Access.

List of Project areas:
1. TDMA, FDMA, CDMA
2. FHSS
3. OFDM
4. Channel Equalisation

Text Books

Reference Books
2. Digital communications - Fundamentals and applications – Bernard Sklar, Prentice Hall

Course Outcomes:
The student will be able to –
1. Understand the concept of linear modulation techniques
2. Understand the concept of non-linear modulation techniques
3. Analyze impact of noise on digital communication systems
4. Understand the role of equalization to improve radio link performance
5. Perform analysis of spread spectrum techniques.
6. Understand the concept of multiple Access techniques for wireless communication.
ET3021: Digital Image Processing

Credits: 4
Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Prerequisite: Students are expected to have knowledge in linear signals and systems, 1-D Fourier Transform, basic linear algebra, basic probability theory and basic programming techniques; knowledge of Digital Signal Processing is desirable.

Section 1:
Introduction to FFT and Digital Filters, Elements of visual perception, Image sampling & Quantization, Basic grey level transformations, histogram processing, enhancement using arithmetic and logic operators, spatial filtering – smoothing and sharpening filters, Median Filter, Inter pixel and image redundancy, 2-D Discrete Fourier Transform and Discrete Cosine Transform, Walsh Hadamard Transform, Fast Walsh Transform, Wavelet Transform, Hough Transform, Neighborhood concepts, adjacency and distance measures, dilation & erosion, opening & closing operations, basic morphological operations such as region filling, thinning, thickening, skeletons, Morphological operations for gray scale images

Section 2:
Detection of discontinuities, edge linking and boundary detection, thresholding, Region based segmentation, use of watersheds, image representation- chain codes, boundary descriptors Compression Fundamentals, Image Compression Models, Error Free Compression, Lossless Predictive Coding, Lossy Predictive Coding, Image Compression Standards – Baseline JPEG, Various Noise Models, Inverse and Wiener Filtering, Image Registration, Mutual Information, Maximum entropy restoration

List of Practicals (Any Six):
1. Image quantization, bit plane slicing
2. Image histogram and thresholding
3. Image enhancement  
4. Image filtering  
5. Edge detection  
6. Mathematical, logical operations  
7. Morphological operations  
8. Application of DFT, DCT  
9. Inverse & Wiener filtering  
10. Image Registration & Mutual Information

**List of Projects (Any One):**
1. Watershed based segmentation  
2. Enhancement and thresholding of medical image  
3. Currency recognition  
4. Vehicle number plate extraction  
5. Count number of similar objects in an image  
6. Noise removal  
7. Detection of annual rings in wood

**Text Books:**

**Reference Books**

**Course Outcomes:**
The Student will be able to-
1. Perform various enhancement operations. (CO Attainment Level: 3)  
2. Analyze image using morphological techniques. (CO Attainment Level: 2)  
3. Apply segmentation techniques to divide image into parts. (CO Attainment Level: 4)  
4. Use various image transforms to analyze and modify image. (CO Attainment Level: 5)  
5. Apply image compression approaches. (CO Attainment Level: 3)  
6. Apply image registration techniques. (CO Attainment Level: 4)
ET3004: Robotics

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Section 2:

List of Practicals (Any Six):
1. Simulation of degree of freedom
2. Simulation of homogeneous transformation
3. Simulation of forward and inverse kinematic
4. Interfacing of proximity sensor with microcontroller
5. Interfacing of actuator with microcontroller
6. Simulation of point-to-point motion
7. Simulation of continuous path motion
8. Simulation of joint space trajectory trajectory
9. Simulation of Cartesian space trajectory
10. Simulation of joint space trajectory with via-points

List of Projects (Any One):
1. Harvest bot
2. Pick and place bot
3. Wall follower Bot
4. Maze solver bot
5. Obstacle avoidance bot
6. Line follower bot

Text Books:

Reference Books:

Course Outcomes:
The student will be able to:
1. Translate specifications to the components of robots such as arms, linkage, drive system and end effector. (CO Attainment Level: 2)
2. Understand the mechanics and kinematics of robot. (CO Attainment Level: 4)
3. Select sensors for a given applications. (CO Attainment Level: 3)
4. Demonstrate use of engineering methods and problem solving toward design of specified robot. (CO Attainment Level: 4)
5. Use robot operating system for application development. (CO Attainment Level: 3)
6. Apply pre-requisite knowledge of programming, microcontroller, sensor interfacing, and operating system for development of robot. (CO Attainment Level: 4)
ET3006: Digital Design

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:
Reconfigurable hardware
Design options for digital systems, Standard Chips, PLDs, FPGAs and ASICs. VLSI design flow. Role of hardware description languages, motivation. Concurrency in hardware, Concept of delta delay. Concept of Micro architecture.
Introduction to Verilog HDL: Levels of Design Description, Concurrency. Verilog Language Constructs and Conventions: Introduction, Keywords, Identifiers, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Operators
Gate Level Modeling: Introduction, Module Structure, Gate Primitives, Tristate buffers, Design of Flip-Flops with Gate Primitives, Net Types, Delay models.
Switch level modeling: MOS switches, CMOS switch, bidirectional switch.
Dataflow Modeling: Introduction, Continuous Assignment Structure, Delays and Continuous Assignments, Assignment to Vector, Operators, user defined primitives.
Test bench: Self checking test bench
Behavioral modeling: Procedural constructs- initial & always block, procedural assignments – blocking and nonblocking statements, difference in blocking and nonblocking statements, active region, inactive region, event scheduling under stratified event queue, event scheduling in Verilog, delay timing control, selection statements- if-else, case, iterative statements-while, for, repeat, forever loop.

Section 2:
Datapath and control path elements: Use of Tasks and functions to design FSM, Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters, RAM, ROM.
Verification: Functional verification, formal and simulation based, test bench design, clock signal generation, reset signal generation, verificational coverage, Dynamic timing analysis, static timing analysis.

List of Practicals (Any Six):
1. To demonstrate the use of gate level modeling (FA)
2. To demonstrate the use of dataflow modeling (MUX, DMUX, LATCH)
3. To demonstrate the use of behavioral modeling (always statement, blocking & non-blocking
4. statements, case statement, combinational circuit description) (MUX, DMUX, decoder, encoder, parity detector)
5. To demonstrate the use of behavioral modeling (always statement, case statement, combinational circuit description) (ALU, code converters)
6. To demonstrate the use of behavioral & structural modeling (flip flop, shift registers)
7. To demonstrate the use of behavioral modeling (up-down counter)
8. To demonstrate the use of behavioral modeling (consecutive ones counter)
9. To demonstrate the use of behavioral modeling (state machine based system)
10. To demonstrate the use of behavioral modeling (RAM, ROM)
11. To demonstrate the use of behavioral modeling (Multipliers, adders)

List of Projects (Any One):
Project based on design, verification and synthesis of functionality like I2C protocol, SPI protocol, RAM, FIFO, vending machine etc.

Text Books:
2. Michel D. Ciletti; Advanced Digital Design with Verilog HDL; PHI, 2009

Reference Books:

Course Outcomes:
The student will be able to –
1. Explain VLSI design flow and basics of Verilog HDL. (CO Attainment Level:2)
2. Develop functionality of combinational circuits using Verilog HDL. (CO Attainment Level:3)
3. Develop functionality of sequential circuits using Verilog HDL. (CO Attainment Level:3)
4. Propose breaking up of large procedures into smaller ones to make it easier to read and debug the source description. (CO Attainment Level:4)
5. Choose Verilog HDL statement for coding and synthesis optimization. (CO Attainment Level:4)
6. Test and verify the functionality described by Verilog HDL. (CO Attainment Level:5)

ET3008: Antenna and Microwave Theory

Credits: 4
Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:
Fundamental Concepts of Antennas:
Overview of Maxwell’s Equation for time varying fields, Poynting’s Theorem, Retarded Potential, Physical concept of radiation, Fields associated with Hertzian dipole, Radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.
Radiation from Wires and Loops & Aperture Antennas
Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop. Huygens’ principle, radiation from rectangular and circular apertures.
Microwave Transmission Lines
Overview of Microwave communication: Microwave communication system, Advantages and applications of Microwaves. Rectangular Waveguides – TE/TM mode analysis, Expressions for Fields, Characteristic Equation and Cut-off Frequencies, Dominant Modes.
Mode Characteristics – Phase velocity and Group Velocity. Power Transmission and Power Losses in Rectangular Waveguide.

Section 2:
Waveguide Components and Applications
Cavity Resonators– Introduction, Rectangular and Cylindrical Cavities, Dominant Modes and Resonant Frequencies, Waveguide Multiport Junctions – E plane Tee, Magic Tee.
Microwave tubes – O type and M type classifications.
HELIX TWTS: Significance, Types and Characteristics of Slow Wave Structures; Structure of TWT , Expressions for o/p Power and Efficiency.
M-type Tubes: Introduction, Cross-field effects, Magnetrons – Different Types, 8-Cavity Cylindrical Travelling Wave Magnetron – Hull Cut-off, Modes of Resonance and PI-Mode Operation, o/p characteristics.
Microstrip Antennas: Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

List of Practicals (Any Six):
1. Simulate antenna using HFSS software
2. Design and simulate of antenna arrays
3. Study of Microwave components
4. Study the characteristics of Reflex klystron
5. Study V-I characteristics of Gunn diode.
7. Plot radiation pattern of Horn antenna using microwave bench.
8. Study port parameters of Circulator
9. Calculate port parameters of Circulator
10. Calculate Directivity, Coupling factor and insertion loss for 10 dB / 20 dB Directional Coupler

List of Projects (Any One):
1. Design and simulate yaggi antenna
2. Design and simulate patch antenna
3. Design and simulate parabolic antenna
4. Design and simulate Horn antenna
5. Design and simulate dipole antenna
6. Wireless power transmission

Text Books:
3. Antenna and Wave Propagation - K.D. Prasad, Satya Prakashan

Reference Books:
2. Microwave Engineering Passive Circuits – Peter A. Rizzi, PHI, 1999
3. Antennas For All Applications – John D.Kraus, 3rd Edition
4. Antenna and wave propagation – A. R. Harish, M, Sachidananda

Course Outcomes:
The student will be able to –
1. Analyze antenna measurements to assess antenna’s performance. (CO Attainment Level: 4)
2. Know the concept of radio wave propagation. (CO Attainment Level: 3)
3. Analyze microwave channel mathematically. (CO Attainment Level: 2)
4. Analyze microwave components mathematically. (CO Attainment Level: 3)
5. Interpret microwave sources mathematically. (CO Attainment Level: 2)
6. Illustrate the different types of arrays and their radiation patterns. (CO Attainment Level: 2)
ET3012: Machine Learning and Computer Vision

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Section 2:
Introduction to machine learning, Linear Regression, Linear Classification, Bayesian Learning and Decision Trees, Linear Discriminant analysis, Support Vector machines, Evaluation Measures and learning models, Clustering, Reinforcement Learning, ANN: perceptron and BP algorithm

List of Practicals (Any Six):
1. Implementation of SIFT / HOG object detector
2. Implement KNN classifier
3. Implement object tracking
4. Implement image registration
5. Implement Naïve Bayes classifier
6. Implement chain code representation
7. Implement k means clustering
8. Implement SVM classifier
9. Neural Networks and Perceptron Example
10. Multilayer Perceptron and Application

List of Projects (Any One):
1. Naïve Bayes classification based projects.
2. Perceptron and linear SVM based projects.
3. Linearly non discriminant data based projects.
4. Clustering technique based projects.

Text Books:

Reference Books

Course Outcomes:
The student will be able to-
1. Develop feature vectors for object detection purpose. (CO Attainment Level: 2)
2. Select algorithm for object recognition. (CO Attainment Level: 3)
3. Discuss image registration techniques. (CO Attainment Level: 3)
4. Discuss the concept of machine learning. (CO Attainment Level: 2)
5. Classify data/ signal using supervised classifiers. (CO Attainment Level: 3)
6. Classify data/ signal using unsupervised classifiers. (CO Attainment Level: 4)
ET3024: Object Oriented Programming

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Section 2:
Polymorphism, Dynamic Binding, Virtual Function Table, Type Casting and cast operators, Multiple Inheritance, Exceptions, Error Handling, Templates: Function Template, I/O streams, File Handling, Threading.

List of Practicals (Any Six):
1. Structures and Unions in C
2. Different Functions and Call Mechanism: Call by Value and Call by Reference
3. Inline Functions
4. Storage Specifiers
5. Constructors and Destructors
6. Multiple Inheritance: Access Specifiers
7. Friend Function and Friend Class
8. Class Template

List of Projects (Any One):
1. Creating Signal Processing Libraries
2. Test Case Generator
3. Call Graph Generation
4. Parallel memory address generation

Text Books:

Reference Books:

Course Outcomes:
The student will be able to –
1. Design classes, function and data structures for applications. (CO Attainment Level: 2)
2. Make use of Operator Overloading concepts. (CO Attainment Level: 3)
3. Apply the concepts of data encapsulation and inheritance. (CO Attainment Level: 3)
4. Create a virtual function for derived class. (CO Attainment Level: 3)
5. Create solutions to a problem by applying the knowledge of Exception handling. (CO Attainment Level: 4)
6. Design an application using File handling. (CO Attainment Level: 5)
ET3025: Database Management System

Credits: 4  
Teaching Scheme: 5 Hours / Week

Theory: 3 Hours / Week  
Lab/ Project: 2 Hours / Week

Section 1:  
Course Overview. Introduction to RDBMS, Structured Query Language (SQL), Relational Algebra, Entity-Relationship Model, Relational Database Design

Section 2:  

List of Practicals (Any Six):  
1. Implementation of DDL commands of SQL
2. Implementation of DML commands
3. Implementation of functions in SQL
4. Implementation of operators in SQL
5. Study and implementation of different types of JOINS
6. Study and implementation of different types clause
7. Study and implementation of sub queries and views
8. Study and implementation of SQL queries (creating database/table and managing users)
9. Study and implementation of PL/SQL
10. Study of standard database models
List of Project areas (Any One):
1. Student information system
2. Library management
3. Courier service
4. Hospital management
5. Employee database management
6. MSRTC database management
7. Inventory database management
8. Exam database management

Text Books:

Reference Books:
1. Database Management Systems, 3rd Edition By Raghu Ramakrishnan and Johannes Gehrke, MGH Education

Course Outcomes:
The student will be able to
1. Examine data structures, file organizations, concepts
2. Understand principles of DBMS’s, data analysis, database design, data modeling,
3. Understand database management, data & query optimization, and database implementation.
4. Study relational data models; entity-relationship modeling, SQL, data normalization, and database design.
5. Practice query coding using MySQL (or any other open system) through various assignments.
ET3010: Biomedical Electronics

Credits: 4
Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:
Diagnostic and Therapeutic Equipment: Cardiac Life support Equipment, Respiratory Care Equipment, ICU & Life Support Equipment, Haemodialyzers and Lithotripters, Diathermy and Radiotherapy. Medical device regulations and standards.
Cardiological Signal Processing:
Neurological Signal Processing:

Section 2:
Radiography: X-Ray, generation of CT, spiral CT, mammography, computed radiography (CR). Magnetic resonance imaging: image acquisition and reconstruction, fast imaging methods, functional imaging, FMRI
Ultrasonic Imaging and Nuclear Imaging: Generation and detection of ultrasound, B-mode, M-mode TM-mode processing, Data acquisition and reconstruction of Doppler image, pulsed wave Doppler, NMI-Radioactive decay modes, data acquisition.
Medical Optics: Optical properties of tissues, Biophotonic Diagnostics: optical biosensors, glucose analysis, flowcytometry, cellular tissue imaging, Optical Coherence Tomography. Photodynamic therapy applications: LASER tissue welding, LASER in dermatology, neurosurgery, ophthalmology and urology.

List of Practicals (Any Six):
1. Determination of Heart Axis by measuring QRS amplitude in the different leads (Lead I, Lead II and Lead III) and Plotting Einthoven Triangle.
2. To study and testing of ECG signal
3. To study and testing of EEG signal
4. Study, Design and measurement of respiration rate using different sensors.
7. Implementation of Template matching algorithm for QRS detection.
8. Implement algorithm for Classification of EEG waves.
9. To measure the components in EEG Signal and Heart Rate Variability in ECG signal simultaneously to understand the inter-relations amongst various physiological parameters
10. Segmentation of lesions from the biomedical images

List of Projects (Any One):
1. Design a Heart rate meter
2. Design a SpO2 sensor.
3. Design PFT sensor
4. Design and testing of Electronic stethoscopes.
5. Design and testing of Electronic Blood Pressure Meters

Text Books:
4. S Webb, "The Physics of Medical Imaging”, Adam Highler, Bristol Published by CRC Press, 1988

Reference Books:
1. John G. Webster Encyclopedia of Medical Devices and Instrumentation

Course Outcomes:
The student will be able to-

1. Design and test the basic Diagnostic and Therapeutic Equipment. (CO Attainment Level: 3)
2. Implement various algorithms for automatic ECG analysis. (CO Attainment Level: 4)
3. Model and detect various EEG patterns. (CO Attainment Level: 3)
4. Implement the image acquisition and reconstruction methods in radiography. (CO Attainment Level: 2)
5. Demonstrate Data acquisition and reconstruction of Doppler image. (CO Attainment Level: 3)
6. Develop applications of LASER in medical field. (CO Attainment Level: 2)
ET3014: Wireless Communication

Credits: 4
Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:
Modern Wireless Communication Systems: Second Generation (2G) Cellular Networks, 2.5G, Third Generation (3G) wireless Networks,
The Cellular Concept: Introduction, Frequency Reuse, Channel Assignment strategies, Hand off Strategies, interference and system capacity, improving coverage and capability in Cellular Systems.
Introduction to Radio wave propagation, free space propagation model, propagation mechanisms, Practical Link Budget design using path loss models, Outdoor propagation models, Indoor propagation models, signal penetration into buildings, Ray tracing and sitespecific modeling.
Small Scale Multi path propagation, small scale multi-path measurements, parameters of mobile multi path channels, Types of small scale fading, Examples of fading behavior.

Section 2:
Performance Evaluation, Signaling Evaluation, Measurement of Average received level & level crossings, Spectrum Efficiency Evaluation, Effects & interferences caused by portable units.
Mobility Management Functions, Mobile Location Management, Mobility Model, Mobile Registration, GSM Token-Based Registration, IMSI Attach and IMSI Detach (Registration
and Deregistration) in GSM, Paging in GSM, Handoff, Handoff Techniques, Handoff Types, Handoff Process and Algorithms, Handoff Call Flows
Common Channel Signaling, Integrated Services Digital Network (ISDN), Introduction to Signaling System No.7(SS7), Global System for mobile (GSM), CDMA, Digital Cellular Standard (IS-95)

List of Practicals (Any Six):
1. Simulation of Rayleigh Fading Channel
2. Simulation of Rician Fading Channel
3. Implementation of IEEE 802.16d model.
4. Simulate Two Ray model to determine the free space loss and the power received
5. Simulate fading environment and loss based on Okumura Hata Model.
6. Simulate multipath fading channels based on COST 207 model.
7. Calculation of worst case cochannel interference ration for different constellations.
8. Simulate BER performance of DS-CDMA in multipath channel for single user case
9. simple OFDM system for transmitting audio data over frequency selective fading channel
10. Simulate multiple-input multiple-output (MIMO) multipath fading channels based on the IEEE® 802.16 channel models for fixed wireless applications.

List of Projects (Any One):
1. OFDM
2. Free Space Propagation
3. DS-CDMA
4. MIMO
5. Up & Down Conversion in Passband Communication
6. Fading

Text Books:

Reference Books:

Course Outcomes:
The student will be able to –

1. Differentiate four generations of wireless standard for cellular networks. (CO Attainment Level: 3)
2. Determine the type and appropriate model of wireless fading channel based on the system parameters and the property of the wireless medium. (CO Attainment Level: 3)
3. Spell the trade-offs among frequency reuse, signal-to-interference ratio, capacity, and spectral efficiency. (CO Attainment Level: 2)
4. Evaluate performance of systems. (CO Attainment Level: 1)
5. Explain mobility in wireless communication System. (CO Attainment Level: 3)
6. Describe wireless standards. (CO Attainment Level: 3)

ET3016: Sensors and Internet of Things

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:
Difference between smart sensor and intelligent sensor, Importance and Adoption of Smart Sensors, Architecture of Smart Sensors: Important components, their features, System design of an IoT System - Power supply, Processor, Memory Sensor Interface, Different hardware platforms for IoT.

Section 2:
IoT Communication Model, IoT networking: IPv6, 6LowPAN, CoAP, and various sensormets protocols (collision avoidance, buffering, reliability), Sensors connectivity and network layer, Gateway layer, Device - device, Device - Cloud, Device - Gateway, Gateway – Cloud.
IoT Cloud platforms, Cloud computing: web services, HTTP, RESTful interactions, service discovery, databases, API, Introduction to Fog and Mist Computing.
Challenges in IoT: Design challenges, Development challenges, Security challenges, Design and development of Security and Privacy Technologies related to IoT.
List of Practicals (Any Six):
1. Setting up the Raspberry Pi
2. Temperature measurement using LM35
3. Intrusion Detection using IR transmitter-receiver
4. Distance measurement using Ultrasonic sensor
5. Temperature measurement using DHT11
6. Raspberry Pi as a webserver
7. Transferring the sensor data to webpages
8. Email alert using SMTP protocol
9. Twitter alert using HTTP protocol
10. Text transfer MQTT protocol on Raspberry Pi

List of Projects (Any One):
1. Smart Home
2. Mobility and Transport
3. Energy Usage Monitoring
4. Smart Grid
5. Air Quality Monitor
6. Anti-Lost Device
7. Smart Clock
8. Smart Parking

Text Books:

Reference Books:
2. Joe Biron and Jonathan Follett, "Foundational Elements of an IoT Solution," by Joe Biron

Course Outcomes:
The student will be able to –
1. Demonstrate the fundamental concepts of Internet of Things. (CO Attainment Level: 3)
2. Select sensors for different IoT applications. (CO Attainment Level: 3)
3. Design IoT applications in different domains. (CO Attainment Level: 5)
4. Apply basic protocols in Wireless Sensor Networks for communication. (CO Attainment Level: 4)

5. Interface sensor data to cloud platforms. (CO Attainment Level: 4)

6. Analyze different challenges in implementing IoT applications. (CO Attainment Level: 3)