

**Dr. Babasaheb Ambedkar Technological University, Lonere.**

**B. Tech (Electronics & Telecommunication Engineering)**  
**Proposed Curriculum for Semester VII [Final Year]**

Sr. No.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTETC701	Professional Core Course 1	Digital Communication	3	0	0	20	20	60	100	3
2	BTETPE702	Program Elective 3	Group A	3	0	0	20	20	60	100	3
3	BTETPE703	Program Elective 4	Group B	3	0	0	20	20	60	100	3
4	BTETPE704	Program Elective 5	Group C	3	0	0	20	20	60	100	3
5	BTHM705	Humanities & Social Science including Management Courses	Financial Management	2	0	0	20	20	60	100	2
6	BTETL706	Program Elective 3 Lab		0	0	2	--	30	20	50	1
7	BTETL707	Program Elective 4 Lab		0	0	2	--	30	20	50	1
8	BTETL708	Program Elective 5 Lab		0	0	2	--	30	20	50	1
9	BTETP709	Project Part I		0	0	8	--	50	50	100	4
10	BTETF611	Field Training/ Internship/Industrial Training Evaluation		--	--	--	--	--	50	50	1
<b>Total</b>				<b>14</b>	<b>0</b>	<b>14</b>	<b>100</b>	<b>240</b>	<b>460</b>	<b>800</b>	<b>22</b>

**Dr. Babasaheb Ambedkar Technological University, Lonere.**

<b>Program Elective - 3 (Group A)</b>	<b>Program Elective -4 (Group B)</b>	<b>Program Elective- 5 (Group C)</b>
(A) Microwave Theory & Techniques	(A) Embedded System Design	(A) Consumer Electronics
(B) RF Circuit Design	(B) Artificial Intelligence Deep learning	(B) Analog Integrated Circuit Design
(C) Satellite Communication	(C) VLSI Design & Technology	(C) Soft Computing
(D) Fiber Optic Communication	(D) Data Compression & Encryption	(D) Advance Industrial Automation-1
(E) Wireless Sensor Networks	(E) Big Data Analytics	(E) Mechatronics
(F) Mobile Computing	(F) Cyber Security	(F) Electronics in Smart City

**B. Tech (Electronics & Telecommunication Engineering)**  
**Course Structure for Semester VIII [Fourth Year] w.e.f. 2020-2021**

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	MSE	CA	ESE	Total	
<ul style="list-style-type: none"> <li>• Introduction to Internet of Things</li> <li>• Computer Vision and Image Processing</li> <li>• Biomedical Signal Processing</li> <li>• Industrial Automation and Control</li> <li>• Cryptography and Network Security</li> <li>• Digital IC Design</li> </ul>			3	-	--	20*	20*	60*	100	3
			3	-	--	20*	20*	60*	100	3
BTMEP803	Project Part-II or Internship*		--	--	30	--	--	100	150	15
<b>Total</b>			--	--				220	350	21

\* Six months of Internship in the industry

\*Students doing project at institute will have to appear for CA/MSE/ESE

\* Student doing project at Industry will give NPTEL examination / Examination conducted by university i.e. CA/MSE/ESE

# These subjects are to be studied on self –study mode using SWAYAM/NPTEL/Any other source

# Teacher who work as a facilitator for the course should be allotted 3 hrs/week load.

# Project Load: 2hrs/week/project.

**Mapping of Courses with MOOCs Platform SWYAM / NPTEL**

No	Course Name	Duration (Weeks)	Institute Offering Course	Name of Professor
1	Introduction to internet of things	12	IIT Kharagpur	Prof. Sudip Misra
2	Computer Vision and Image Processing	12	IIT Gandhinagar	Prof. M. K. Bhuyan
3	Biomedical Signal Processing	12	IIT Kharagpur	Prof. Sudipta Mukhopadhyay
4	Industrial Automation and Control	12	IIT Kharagpur	Prof. Siddhartha Mukhopadhyay
5	Cryptography & Network Security	12	IIT Kharagpur	Prof. Sourav Mukhopadhyay
6	Digital IC Design	12	IIT Madras	Prof. Janakiraman

## **Dr. Babasaheb Ambedkar Technological University, Lonere.**

2. R. S. Aggarwal, "A modern approach to verbal reasoning", S. Chand publications.
3. Philip Carter, "The Complete Book of Intelligence Test", John Willey & Sons Ltd.
4. Philip Carter, Ken Russell, "Succeed at IQ test", Kogan Page.
5. Eugene Ehrlich, Daniel Murphy, "Schaum's Outline of English Grammar", McGraw Hills.
6. David F. Beer, David A. Mc Murrey, "A Guide to Writing as an Engineer", ISBN: 978-1-118-30027-5 4<sup>th</sup> Edition, 2014, Wiley.

**BTETC701**

**Digital Communication**

**3 Credits**

### **Course Objectives:**

- To understand the building blocks of digital communication system.
- To prepare mathematical background for communication signal analysis.
- To understand and analyze the signal flow in a digital communication system.
- To analyze error performance of a digital communication system in presence of noise and other interferences.
- To understand concept of spread spectrum communication system.

### **Course Outcomes:**

1. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
2. Perform the time and frequency domain analysis of the signals in a digital communication system.
3. Select the blocks in a design of digital communication system.
4. Analyze Performance of spread spectrum communication system.

## **UNIT - 1**

### **Digital Transmission of Analog Signal**

Introduction to Digital Communication System: Why Digital?, Block Diagram and transformations, Basic Digital Communication Nomenclature. Digital Versus Analog Performance Criteria, Sampling Process, PCM Generation and Reconstruction, Quantization Noise, Non-uniform Quantization and Companding, PCM with noise: Decoding noise, Error

threshold, Delta Modulation, Adaptive Delta Modulation, Delta Sigma Modulation, Differential Pulse Code Modulation, LPC speech synthesis.

**UNIT - 2**

**Baseband Digital Transmission**

Digital Multiplexing: Multiplexers and hierarchies, Data Multiplexers. Data formats and their spectra, synchronization: Bit Synchronization, Scramblers, Frame Synchronization. Inter-symbol interference, Equalization.

**UNIT - 3**

**Random Processes**

Introduction, Mathematical definition of a random process, Stationary processes, Mean, Correlation & Covariance function, Ergodic processes, Transmission of a random process through a LTI filter, Power spectral density, Gaussian process, noise, Narrow band noise, Representation of narrowband noise in terms of in phase & quadrature components.

**UNIT - 4**

**Baseband Receivers**

Detection Theory: MAP, LRT, Minimum Error Test, Error Probability, Signal space representation: Geometric representation of signal, Conversion of continuous AWGN channel to vector channel, Likelihood functions, Coherent Detection of binary signals in presence of noise, Optimum Filter, Matched Filter, Probability of Error of Matched Filter, Correlation receiver.

**UNIT - 5**

**Passband Digital Transmission**

Pass band transmission model, Signal space diagram, Generation and detection, Error Probability derivation and Power spectra of coherent BPSK, BFSK and QPSK. Geometric representation, Generation and detection of - M-ary PSK, M-ary QAM and their error probability, Generation and detection of -Minimum Shift Keying, Gaussian MSK, Non-coherent BFSK, DPSK and DE PSK ,Introduction to OFDM.

UNIT - 6

**Spread Spectrum Techniques**

Introduction, Pseudo noise sequences, A notion of spread spectrum, Direct sequence spread spectrum with coherent BPSK, Signal space dimensionality & processing gain, Probability of error, Concept of jamming, Frequency hop spread spectrum, Wireless Telephone Systems, Personal Communication System.

**TEXT/REFERENCE BOOKS**

1. Simon Haykin, "Digital Communication Systems", John Wiley & Sons, Fourth Edition.
2. A.B Carlson, P B Crully, J C Rutledge, "Communication Systems", Fourth Edition, McGraw Hill Publication.
3. Ha Nguyen, Ed Shwedyk, "A First Course in Digital Communication", Cambridge University Press.
4. B P Lathi, Zhi Ding "Modern Analog and Digital Communication System", Oxford University Press, Fourth Edition.
5. Bernard Sklar, Prabitra Kumar Ray, "Digital Communications Fundamentals and Applications" Second Edition, Pearson Education.
6. Taub, Schilling, "Principles of Communication System", Fourth Edition, McGraw Hill.
7. P Ramkrishna Rao, Digital Communication, Mc Graw Hill Publication.

**BTETPE702A**

**Microwave Theory and Techniques**

**3 Credits**

**Course Objectives:**

- To lay the foundation for microwave engineering.
- To understand the applications of microwave engineering.
- Carryout the microwave network analysis.

**Course Outcomes:**

After successfully completing the course students will be able to

1. Formulate the wave equation in wave guide for analysis.
2. Identify the use of microwave components and devices in microwave applications.
3. Understand the working principles of all the microwave tubes.

4. Understand the working principles of all the solid state devices.
5. Choose a suitable microwave tube and solid state device for a particular application.
6. Carry out the microwave network analysis.
7. Choose a suitable microwave measurement instruments and carry out the required measurements.

### **UNIT - 1**

#### **Transmission Lines and Waveguides:**

Introduction to Microwaves engineering: History of Microwaves, Microwave Frequency bands. Applications of Microwave, General solution for TEM, TE and TM waves, Parallel plate waveguide, and rectangular waveguide, Wave guide parameters, Introduction to coaxial line, Rectangular waveguide cavity resonators, Circular waveguide cavity resonators.

### **UNIT - 2**

#### **Microwave Components:**

Multi-port junctions: Construction and operation of E-plane, H-plane, Magic Tee and Directional couplers. Ferrites components: - Ferrite Composition and characteristics, Faraday rotation, Construction and operation of Gyrotator, Isolator and Circulator.

Striplines: Structural details and applications of Striplines, Microstrip line, Parallel Strip line, Coplanar Strip line, Shielded Strip Line.

### **UNIT - 3**

#### **Microwave Network Analysis**

Introduction and applications of Impedance and Equivalent voltages and currents, Impedance and Admittance matrices, The Transmission (ABCD) matrix Scattering Matrix:- Significance, formulation and properties. S-Matrix calculations for-2 port network junction, E plane, H-plane and E-H (Magic Tee) Tees, Directional coupler, Isolator and Circulator. Related problems.

### **UNIT - 4**

#### **Microwave Tubes**

Limitations of conventional tubes, O and M type classification of microwave tubes, reentrant cavity, velocity modulation. O type tubes Two cavity Klystron: Construction and

principle of operation, velocity modulation and bunching process Applegate diagram. Reflex Klystron: Construction and principle of operation, velocity modulation and bunching process, Applegate diagram, Oscillating modes, o/p characteristics, efficiency, electronic & mechanical tuning. M-type tubes Magnetron: Construction and Principle of operation of 8 cavity cylindrical travelling wave magnetron, hull cutoff condition, modes of resonance, PI mode operation, o/p characteristics, Applications. Slow wave devices Advantages of slow wave devices, Helix TWT: Construction and principle of operation, Applications.

#### **UNIT - 5**

Microwave bipolar transistor, FET, MESFET, Varactor Diode, PIN Diode, Schottky Barrier Diode, Tunnel Diode, TEDs, Gunn Diodes, IMPATT diode and TRAPATT diode. Structural details, Principle of operation, various modes, specifications, and applications of all these devices.

#### **UNIT - 6**

##### **Microwave Measurements**

Measurement devices: Slotted line, Tunable detector, VSWR meter, Power Meter, S-parameter measurement, frequency measurements, Power measurement, Attenuation measurement, Phase shift measurement, VSWR measurement, Impedance measurement, Q of cavity resonator measurement.

#### **TEXT/REFERENCE BOOKS**

1. Microwave Engineering – Annapurna Das, Sisir K Das TMH Publication, 2nd, 2010
2. Microwave Devices and circuits- Liao / Pearson Education
3. Antennas and Wave Propagation, John D. Krauss, Ronald J Marhefka and Ahmad S Khan, 4thSpecial Indian Edition , McGraw- Hill Education Pvt. Ltd., 2010.
4. Microwave Engineering – David M Pozar, John Wiley India Pvt. Ltd., 3rdEdn, 2008
5. Microwave Engineering – Sushrut Das, Oxford Higher Education, 2ndEdn, 2015
6. Antennas and Wave Propagation – Harish and Sachidananda: Oxford University Press, 2007.



BTETPE702B

RF Circuit Design

3 Credits

**Course Objectives:**

- To study RF issues related to active and passive components.
- To study circuit design aspects at RF
- To learn design and modeling of circuits at RF.

**Course Outcomes:**

After successfully completion of the course students will be able to

1. Understand behavior of passive components at high frequency and modeling of HF circuit.
2. Design HF amplifiers with gain bandwidth parameters.
3. Understand Mixer types and characteristics.
4. Gain the knowledge about PLLs and Oscillators with respect to their circuit topologies.

**UNIT - 1**

**RF Behavior of Passive Components**

HF Resistors, HF Capacitors, HF Inductors, Chip Components. Circuit Board Considerations: Chip Resistors, Chip Capacitors, Surface Mounted Inductors.

**UNIT - 2**

**Bandwidth Estimation**

Open Circuit Time Constant Method: Observations & Interpretations, Accuracy of OC  $\tau$ s, Considerations, and Design examples. Short Circuit Time Constant Method: Background, Observations & Interpretations, Considerations. Delay of a system in cascade, Rise time of systems in cascade, Relation between Rise Time and Bandwidth.

**UNIT - 3**

**High Frequency Amplifier Design**

Shunt Peaked Amplifier, Shunt Series peak Amplifier, Two port bandwidth enhancement, Design example. Bandwidth enhancement techniques. Tuned Amplifier: Common Source Amplifier with Single Tuned Load, Analysis of Tuned Amplifier. Neutralization and unilateralization. Characteristics of RF amplifier. Amplifier power relations. Stability considerations, Stabilization methods.

**UNIT - 4**

**Low Noise Amplifier Design**

MOSFET two port noise parameters, LNA topologies, Power-constrained noise optimization. Design examples: Single ended LNA, Differential LNA. Linearity and large signal performance. Spurious free dynamic range.

**UNIT - 5**

**Oscillators**

Problem with Purely Linear Oscillators, Describing Functions, Describing Function for MOS. Colpitts Oscillator: Describing Function Model and Start-up Model of Colpitts Oscillator. Resonators: Quarter-Wave Resonators, Quartz Crystals. Tuned Oscillators: Basic LC Feedback Oscillators, Crystal Oscillator. Negative Resistance Oscillator.

**UNIT - 6**

**Mixers**

Mixer Fundamentals. Significant Characteristics of Mixer: Conversion Gain, Noise Figure, Linearity and Isolation, Spurs. Non Linear Systems as Linear Mixers. Multiplier Based Mixers: Single Balanced Mixer, Linearization techniques of Mixer, Active Double Balanced Mixer. Passive Double Balanced Mixer, Diode Ring Mixers.

**TEXT/REFERENCE BOOKS**

1. Reinhold Ludwig, Pavel Bretchko, "RF Circuit Design Theory and Applications", Pearson Education.
2. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", Second Edition, Cambridge Publications.
3. T. Yettrdal, Yunhg Cheng, "Devices modeling for analog and RF COMS circuits design", John Wiley publication.
4. Calvin Plett, "Radio frequency Integrated Circuits Design", Artech house.

BTETPE702C

Satellite Communication

3 Credits

**Course Objectives:**

- To provide students with good depth of knowledge in radar and Satellite communication.
- Knowledge of theory and practice of advanced communication techniques e.g. TDMA, CDMA, FDMA.
- This will equip the students for further studies and research knowledge of modern applications in radar and Satellite communication.

**Course Outcomes:**

At the end of the course, the students will have:

1. Knowledge of theory and practice related to radar and Satellite communication.
2. Ability to identify, formulate and solve engineering problems related to radar and Satellite communication.
3. The student would be able to analyze the various aspects of establishing a geo-stationary satellite communication link.
4. Acquired knowledge about Satellite Navigation System.
5. Acquired knowledge about Radar and Radar Equations.

**UNIT - 1**

**Basic Principles**

General features, frequency allocation for satellite services, properties of satellite communication systems.

**Earth Station:** Introduction, earth station subsystem, different types of earth stations.

**UNIT - 2**

**Satellite Orbits**

Introduction, Kepler's laws, orbital dynamics, orbital characteristics, satellite spacing and orbital capacity, angle of elevation, eclipses, launching and positioning, satellite drift and station keeping.

**UNIT - 3**

**Satellite Construction (Space Segment)**

Introduction; attitude and orbit control system; telemetry, tracking and command; power systems, communication subsystems, antenna subsystem, equipment reliability and space qualification.

**UNIT - 4**

**Satellite Links**

Introduction, general link design equation, system noise temperature, uplink design, downlink design, complete link design, effects of rain.

**UNIT - 5**

**The Space Segment Access and Utilization**

Introduction, space segment access methods: TDMA, FDMA, CDMA, SDMA, assignment methods.

**UNIT - 6**

**The Role and Application of Satellite Communication**

Introduction to Digital Satellite and Mobile Satellite Communication.

**TEXT/REFERENCE BOOKS**

1. Timothy Pratt, Charles W. Bostian, Satellite Communications, John Wiley & Sons.
2. Dennis Roddy, Satellite Communications, 3rd Ed., McGraw-Hill International Ed. 2001.
3. W. L. Pritchard, J. A. Sciulli, Satellite Communication Systems Engineering, Prentice-Hall, Inc., NJ.
4. M. O. Kolawole, Satellite Communication Engineering, Marcel Dekker, Inc. NY.
5. Robert Gagliardi , "Satellite Communication" , CBS Publication.
6. Ha, "Digital Satellite Communication", McGraw- Hill.
7. Timothy Pratt and Charles Bostian, "Satellite Communications", John Wiley and Sons.

**Course Objectives:**

- To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
- To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
- To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes
- Understand the functionality of each of the components that comprise a fiber-optic communication system: transmitter, fiber, amplifier, and receiver.
- Understand the properties of optical fiber that affect the performance of a communication link.
- Understand basic optical amplifier operation and its effect on signal power and noise in the system.
- Apply concepts listed above to the design of a basic communication link.

**Course Outcomes:**

At the end of the course, students will demonstrate the ability to:

1. Understand the principles fiber-optic communication, the components and the bandwidth advantages.
2. Understand the properties of the optical fibers and optical components.
3. Understand operation of lasers, LEDs, and detectors.
4. Analyze system performance of optical communication systems.
5. Design optical networks and understand non-linear effects in optical fibers

**UNIT - 1**

**Introduction**

Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model.

**UNIT - 2**

**Types of optical fibers**

Different types of optical fibers, Modal analysis of a step index fiber, Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.

**UNIT - 3**

**Optical sources**

LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties

**UNIT - 4**

**Optical switches**

Coupled mode analysis of directional couplers, electro-optic switches.

**UNIT - 5**

**Optical amplifiers**

EDFA, Raman amplifier, WDM and DWDM systems, Principles of WDM networks.

**UNIT - 6**

**Nonlinear effects in fiber optic links**

Nonlinear effects in fiber optic links, Concept of self-phase modulation, group velocity dispersion and soliton based communication.

**TEXT/REFERENCE BOOKS**

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
3. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.
5. G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
6. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997

7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

**BTETPE702E**

**Wireless Sensor Networks**

**3 Credits**

**Course Objectives:**

- To introduce the emerging research areas in the field of wireless sensor networks
- To understand different protocols and their uses in WSN.

**Course Outcomes:**

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

1. Design wireless sensor networks for a given application
2. Understand emerging research areas in the field of sensor networks
3. Understand MAC protocols used for different communication standards used in WSN
4. Explore new protocols for WSN.

**UNIT - 1**

**Introduction**

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

**UNIT - 2**

**Networks**

Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.

**UNIT - 3**

**Protocols**

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee.

**UNIT - 4**

**Dissemination protocol**

Dissemination protocol for large sensor network, Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

**UNIT - 5**

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.

**UNIT - 6**

Single-node architecture, Hardware components & design constraints, Operating systems and execution environments.

**TEXT/REFERENCE BOOKS**

1. Waltenege Dargie , Christian Poellabauer, “ Fundamentals Of Wireless Sensor Networks Theory And Practice” , By John Wiley & Sons Publications ,2011
2. Sabrie Soloman, “Sensors Handbook" by McGraw Hill publication. 2009
3. Feng Zhao, Leonidas Guibas, “ Wireless Sensor Networks” , Elsevier Publications,2004
4. Kazem Sohrby, Daniel Minoli, “Wireless Sensor Networks”: Technology, Protocols and Applications, Wiley-Inter science
5. Philip Levis, And David Gay "Tiny OS Programming” by Cambridge University Press 2009.

**BTETPE702F**

**Mobile Computing**

**3 Credits**

**Course Objectives:**

- To provide guidelines, design principles and experience in developing applications for small, mobile devices, including an appreciation of context and location aware services.
- To introduce wireless communication and networking principles, that support connectivity to cellular networks, wireless internet and sensor devices.
- To appreciate the social and ethical issues of mobile computing, including privacy.

**Course Outcomes:**

1. At the end of the course, the student will be able to demonstrate:
2. A working understanding of the characteristics and limitations of mobile hardware devices including their user-interface modalities
3. The ability to develop applications that are mobile-device specific and demonstrate current practice in mobile computing contexts.



4. A comprehension and appreciation of the design and development of context-aware solutions for mobile devices.
5. An awareness of professional and ethical issues, in particular those relating to security and privacy of user data and user behavior.

#### **UNIT - 1**

Mobile Computing, Mobile Computing vs. wireless Networking, Mobile Computing Applications, Characteristics of Mobile computing, Structure of Mobile Computing Application.

#### **UNIT - 2**

MAC Protocols, Wireless MAC Issues, Fixed Assignment Schemes, Random Assignment Schemes, Reservation Based Schemes.

#### **UNIT - 3**

Overview of Mobile IP, Features of Mobile IP, Key Mechanism in Mobile IP, route Optimization. Overview of TCP/IP, Architecture of TCP/IP- Adaptation of TCP Window, Improvement in TCP Performance.

#### **UNIT - 4**

Global System for Mobile Communication (GSM), General Packet Radio Service (GPRS), Universal Mobile Telecommunication System (UMTS).

#### **UNIT - 5**

Ad-Hoc Basic Concepts , Characteristics , Applications , Design Issues , Routing , Essential of Traditional Routing Protocols ,Popular Routing Protocols , Vehicular Ad Hoc networks (VANET) , MANET vs. VANET , Security.

#### **UNIT - 6**

Mobile Device Operating Systems , Special Constrains & Requirements , Commercial Mobile Operating Systems , Software Development Kit: iOS, Android, BlackBerry, Windows Phone , M Commerce , Structure , Pros & Cons , Mobile Payment System , Security Issues.

#### **TEXT/REFERENCE BOOKS**

1. Principles of Mobile Computing, 2<sup>nd</sup> Edition, Uwe Hansmann, Lothar Merk, Martin Nicklous, Thomas Stober, Springer

2. Mobile Computing, Tomasz Imielinski, Springer.

**BTETPE703A**

**Embedded System Design**

**3 Credits**

**Course Objectives:**

- To understand the embedded system design issues.
- To learn real time operating system concepts.
- To understand the Embedded Linux environment.
- To learn embedded software development and testing process.

**Course Outcomes:**

At the end of the course, students will demonstrate the ability to:

1. Suggest design approach using advanced controllers to real-life situations.
2. Design interfacing of the systems with other data handling / processing systems.
3. Appreciate engineering constraints like energy dissipation, data exchange speeds etc.
4. Get to know the hardware – software co design issues and testing methodology for embedded system.

**UNIT - 1**

**Introduction to Embedded Computing**

The concept of embedded systems design, Characteristics of Embedding Computing Applications, Concept of Real time Systems

**UNIT - 2**

**Design Process**

Requirements, Specifications, Architecture Design, Designing of Components, Embedded microcontroller cores, embedded memories. Examples of embedded systems

**UNIT - 3**

**Technological aspects of embedded systems**

Interfacing between analog and digital blocks, signal conditioning, digital signal processing, subsystem interfacing, interfacing with external systems, user interfacing.

**UNIT - 4**

**Design tradeoffs**

Design tradeoffs due to process compatibility, thermal considerations, etc., Software aspects of embedded systems: real time programming languages and operating systems for embedded systems

**UNIT - 5**

**Operating System**

Basic Features of an Operating System, Kernel Features: Real-time Kernels, Polled Loops System, Co-routines, Interrupt-driven System, Multi-rate System Processes and Threads, Context Switching: Cooperative Multi-tasking, Pre-emptive Multi- tasking.

**UNIT - 6**

**Scheduling and Inter-process Communication**

Rate-Monotonic Scheduling, Earliest-Deadline First Scheduling, Task Assignment, Fault-Tolerant Scheduling Signals, Shared Memory Communication, Message-Based Communication

**TEXT/REFERENCE BOOKS**

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
3. V.K. Madiseti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

**BTETPE703B**

**Artificial Intelligence Deep Learning**

**3 Credits**

**Course Objectives:**

- Apply AI techniques to solve the given problems.
- Implement trivial AI techniques on relatively large system
- Explain uncertainty and Problem solving techniques.
- Compare various learning techniques.

**Course Outcomes:**

This course will enable students to

1. Identify the AI based problems.
2. Apply techniques to solve the AI problems.
3. Define learning and explain various logic inferences.
4. Discuss different learning techniques.

**UNIT - 1**

**Introduction:**

What Is AI? Thinking humanly: The cognitive modeling approach. Thinking rationally: The “laws of thought” approach, Acting rationally: The rational agent approach. The Foundations of Artificial Intelligence, Mathematics, Economics, Neuroscience, Computer engineering, The History of Artificial Intelligence. AI becomes an industry (1980-- present). Agents and Environments, Good Behaviour: The Concept of Rationality. The Nature of Environments. The Structure of Agents.

**UNIT - 2**

**Search Techniques:**

Problem-Solving Agents, Well-defined problems and solutions, Formulating problems, Real-world problems. Uninformed Search Strategies, Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bidirectional search, Informed (Heuristic) Search Strategies, Greedy best-first search, A\* search: Minimizing the total estimated solution cost, Heuristic Functions. The effect of heuristic accuracy on performance. Beyond Classical Search, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces.

**UNIT - 3**

**Game Playing:**

Games, Optimal Decisions in Games, The minimax algorithm, Optimal decisions in multiplayer games, Alpha Beta Pruning, Move ordering, Imperfect Real-Time Decisions, Cutting off search, Forward pruning, Stochastic Games, Evaluation functions for games of chance, Partially Observable Games, Krieg spiel: Partially observable chess, Card games, State-of-the-Art Game Programs, Alternative Approaches.

**UNIT - 4**

**Logic and inference:**

Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems, Knowledge-Based Agents, The Wumpus World, Logic , Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic. Forward Chaining, Backward Chaining, Definition of Classical Planning. Algorithms for Planning as State-Space Search, Planning Graphs.

**UNIT - 5**

**Learning:**

Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Model selection: Complexity versus goodness of fit, From error rates to loss, Regularization, The Theory of Learning, Regression and Classification with Linear Models, Artificial Neural Networks, Nonparametric Models, Ensemble Learning, Online Learning, Practical Machine Learning, A Logical Formulation of Learning. Knowledge in Learning. Explanation-Based Learning, Learning Using Relevance Information. Inductive Logic Programming. Statistical Learning. Learning with Complete Data. Learning with Hidden Variables: The EM Algorithm.

**TEXT/REFERENCE BOOKS**

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach. III Edition
2. E. Rich, K. Knight & S. B. Nair - Artificial Intelligence, 3/e, McGraw Hill.
3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India.
4. G. Luger, “Artificial Intelligence: Structures and Strategies for complex problem Solving”, Fourth Edition, Pearson Education, 2002.
5. N.P. Padhy “Artificial Intelligence and Intelligent Systems” , Oxford University Press- 2015.

**Course Objectives:**

- To study HDL based design approach.
- To learn digital CMOS logic design.
- To nurture students with CMOS analog circuit designs.
- To realize importance of testability in logic circuit design.
- To overview SoC issues and understand PLD architectures with advanced features.

**Course Outcomes:**

After successfully completing the course, students will be able to

1. Model digital circuit with HDL, simulate, synthesis and prototype in PLDs.
2. Understand chip level issues and need of testability.
3. Design analog & digital CMOS circuits for specified applications

**UNIT - 1**

**VHDL Modeling**

Data objects, Data types, Entity, Architecture & types of modeling, Sequential statements, Concurrent statements, Packages, Sub programs, Attributes, VHDL Test bench, Test benches using text files. VHDL modeling of Combinational, Sequential logics & FSM, Meta-stability.

**UNIT - 2**

**PLD Architectures**

PROM, PLA, PAL: Architectures and applications. Software Design Flow, CPLD Architecture, Features, Specifications, Applications, FPGA Architecture, Features, Specifications, Applications.

**UNIT - 3**

**SoC & Interconnect**

Clock skew, Clock distribution techniques, clock jitter, Supply and ground bounce, power distribution techniques. Power optimization, Interconnect routing techniques; wire parasitic, Signal integrity issues, I/O architecture, pad design, Architectures for low power.

**UNIT - 4**

**Digital CMOS Circuits**

MOS Capacitor, MOS Transistor theory, C-V characteristics, Non ideal I-V effects, Technology Scaling. CMOS inverters, DC transfer characteristics, Power components, Power delay product, Transmission gate. CMOS combo logic design, Delays: RC delay model, Effective resistance, Gate and diffusion capacitance, Equivalent RC circuits; Linear delay model, Logical effort, Parasitic delay, Delay in a logic gate, Path logical efforts.

**UNIT - 5**

**Analog CMOS Design**

Current sink and source, Current mirror, Active load, Current source and Push-pull inverters, Common source, Common drain, Common gate amplifiers. Cascade amplifier, Differential amplifier, Operational amplifier

**UNIT - 6**

**Testability**

Types of fault, Need of Design for Testability (DFT), Testability, Fault models, Path sensitizing, Sequential circuit test, BIST, Test pattern generation, JTAG & Boundary scan, TAP Controller.

**TEXT/REFERENCE BOOKS**

1. Charles H. Roth, "Digital systems design using VHDL", PWS.
2. Wyane Wolf, "Modern VLSI Design (System on Chip)", PHI Publication.
3. Allen Holberg, "Analog CMOS Design", Oxford University Press.
4. Neil H. E. Weste, David Money Harris, "CMOS VLSI Design: A Circuit & System Perspective", Pearson Publication.

BTETPE703D

Data Compression & Encryption

3 Credits

**Course Objectives:**

- The concept of security, types of attack experienced.
- Encryption and authentication for deal with attacks, what is data compression, need and techniques of data compression.

**Course Outcomes:**

At the end of this course

1. The student will have the knowledge of Plaintext, cipher text, RSA and other cryptographic algorithm.
2. The student will have the knowledge of Key Distribution, Communication Model, Various models for data compression.

**UNIT - 1**

**Data Compression and Encryption:**

Need for data compression, Lossy/lossless compression, symmetrical compression and compression ratio, run length encoding for text and image compression, relative encoding and its applications in facsimile data compression and telemetry, scalar and quantization.

**UNIT - 2**

**Statistical Methods:**

Statistical modeling of information source, coding redundancy, variable size codes, prefix codes, Shannon- Fano coding, Huffman coding, adaptive Huffman coding, arithmetic coding and adaptive arithmetic coding, text compression using PPM method.

**UNIT - 3**

**Dictionary Methods:**

String compression, sliding window compression, LZ77, LZ78 and LZW algorithms and applications in text compression, zip and Gzip, ARC and Redundancy code.

**UNIT - 4**

**Image Compression:**

Lossless techniques of image compression, gray codes, two dimensional image transform ,Discrete cosine transform and its application in lossy image compression, quantization, Zig-Zag coding sequences, JPEG and JPEG-LS compression standards, pulse code modulation



and differential pulse code modulation methods of image compression, video compression and MPEG industry standard.

**UNIT - 5**

**Audio Compression:**

Digital audio, lossy sound compression, M-law and A-law companding, DPCM and ADPCM audio compression, MPEG audio standard, frequency domain coding, format of compressed data.

**UNIT - 6**

**Conventional Encryption:**

Security of information, security attacks, classical techniques, caesar Cipher, block cipher principles, data encryption standard, key generation for DES, block cipher principle, design and modes of operation, S-box design, triple DES with two three keys, introduction to international data encryption algorithm, key distribution.

**TEXT/REFERENCE BOOKS**

1. Data compression- David Solomon Springer Verlag publication.
2. Cryptography and network security- William Stallings Pearson Education Asia Publication.
3. Introduction to data compression-Khalid Sayood Morgan kaufmann publication.
4. The data compression book- Mark Nelson BPB publication.
5. Applied cryptography-Bruce schneecer, John Wiley and sons Inc., publications.

**BTETPE703E**

**Big Data Analytics**

**3 Credits**

**Course Objectives:**

- To provide an overview of an exciting growing field of Big Data analytics.
- To discuss the challenges traditional data mining algorithms face when analyzing Big Data.
- To introduce the tools required to manage and analyze big data like Hadoop, NoSql Map Reduce.

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- To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability
- To introduce to the students several types of big data like social media, web graphs and data streams
- To enable students to have skills that will help them to solve complex real-world problems in for decision support.

### Course Outcomes:

At the end of this course, Students will able to:

1. Explain the motivation for big data systems and identify the main sources of Big Data in the real world.
2. Demonstrate an ability to use frameworks like Hadoop, NOSQL to efficiently store retrieve and process Big Data for Analytics.
3. Implement several Data Intensive tasks using the Map Reduce Paradigm
4. Apply several newer algorithms for Clustering Classifying and finding associations in Big Data.

### UNIT - 1

#### Big Data Platforms

Big Data Platforms for the Internet of Things: network protocol- data dissemination –current state of art- Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness: interoperability problem in the IoT context- Big Data Management Systems for the Exploitation of Pervasive Environments - Big Data challenges and requirements.

### UNIT - 2

**YA TRAP** – Necessary and sufficient condition for false authentication prevention - Adaptive Pipelined Neural Network Structure in Self-aware Internet of Things: self-healing systems Role of adaptive neural network- Spatial Dimensions of Big Data: Application of Geographical Concepts and Spatial Technology to the Internet of Things- Applying spatial relationships, functions, and models.

**UNIT - 3**

**Fog Computing**

Fog Computing: A Platform for Internet of Things and Analytics: a massively distributed number of sources - Big Data Metadata Management in Smart Grids: semantic inconsistencies - role of metadata.

**UNIT - 4**

**Web Enhanced Building**

Toward Web Enhanced Building Automation Systems: heterogeneity between existing installations and native IP devices - loosely-coupled Web protocol stack –energy saving in smart building- Intelligent Transportation Systems and Wireless Access in Vehicular Environment Technology for Developing Smart Cities: advantages and achievements.

**UNIT - 5**

**Technologies for Healthcare**

Emerging Technologies in Health Information Systems: Genomics Driven Wellness Tracking and Management System (GO-WELL) – predictive care – personalized medicine.

**UNIT - 6**

**Sustainability Data and Analytics**

Sustainability Data and Analytics in Cloud-Based M2M Systems - potential stakeholders and their complex relationships to data and analytics applications - Social Networking Analysis - Building a useful understanding of a social network - Leveraging Social Media and IoT to Bootstrap Smart Environments: lightweight Cyber Physical Social Systems - citizen actuation.

**TEXT/REFERENCE BOOKS**

1. Stackowiak, R., Licht, A., Mantha, V., Nagode, L.,” Big Data and the Internet of Things Enterprise Information Architecture for A New Age”, Apress, 2015. 2. Dr. John Bates, “Thingalytics - Smart Big Data Analytics for the Internet of Things”, john Bates, 2015.
2. Dr. John Bates, “Thingalytics - Smart Big Data Analytics for the Internet of Things”, john Bates, 2015.

BTETPE703F

Cyber Security

3 Credits

**Course Objectives:**

- For secured and under control since the information stored and conveyed is ultimately an invaluable resource of the business.
- The growing number of the computer Network(internet/intranet) attacks and sophistication in attack technologies has made this task still more complicated
- To update the knowledge of the personnel manning networks and systems on the network security issues and solutions.

**Course Outcomes:**

Students should be able to understand.

1. The difference between threat, risk, attack and vulnerability.
2. How threats materialize into attacks.
3. Where to find information about threats, vulnerabilities and attacks.
4. Typical threats, attacks and exploits and the motivations behind them.

**UNIT - 1**

**Introduction to Cyber Security**

Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats – Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.

**UNIT - 2**

**Cyber Security Vulnerabilities and Cyber Security Safeguards**

Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

**UNIT - 3**

**Securing Web Application, Services and Servers**

Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.

**UNIT - 4**

**Intrusion Detection and Prevention**

Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

**UNIT - 5**

**Cryptography and Network Security**

Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

**UNIT - 6**

**Cyberspace and the Law, Cyber Forensics**

Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013 Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.

**TEXT/REFERENCE BOOKS**

1. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, Security in Computing, 5th Edition , Pearson Education , 2015

2. George K.Kostopoulos, Cyber Space and Cyber Security, CRC Press, 2013.
3. Martti Lehto, Pekka Neittaanmäki, Cyber Security: Analytics, Technology and Automation edited, Springer International Publishing Switzerland 2015.
1. Nelson Phillips and Einfinger Steuart, —Computer Forensics and Investigations, Cengage Learning, New Delhi, 2009.

**BTETPE704A**

**Consumer Electronics**

**3 Credits**

**Course Objectives:**

- To acquaint students with the practical knowledge of designing and developing consumer electronic systems and products and introduce the latest trends and technologies.

**Course Outcomes:**

Students will be able to:

1. List technical specification of electronics Audio system (microphone and speaker)
2. Trouble shoots consumer electronics products like TV, washing machine and AC.
3. Identify and explain working of various color TV transmission blocks.
4. Adjust various controls of color TV receiver and troubleshoot it.
5. Use various functions of Cam coder and shoot a video and take snapshots and save them in appropriate format.

**UNIT - 1**

**Communication devices**

Mobile handsets, Android technology, 2G, 3G Mobiles, i-phone, EPABX

**UNIT - 2**

**Mass Communication devices**

Color Television, Antenna, HDTV, LCD TV, LED TV, 3D Technology In TV, Interactive TV, DTHTV, Plasma TV, Video Conferencing, FAX Machine, PA System, Dolby Digital Systems, Gesture Technology In TV.

**UNIT - 3**

**Household electronics devices**

Washing Machine, Microwave Oven, Types Applications, Electronics Weighing Balance, Air Conditioner, Vacuum Cleaner.

**UNIT - 4**

**Printing and recording devices**

LASER printer, Inkjet Printers, Photocopiers, Scanner, DVD/CD Player, Blue ray DVD Player.

**UNIT - 5**

**Special purpose machines**

Electronic Voting Machine, CFL, LED Lamps, Application and Advantages. Solar lamp, Water Purifier, Electronic Calculator, DVD Player, ATM

**Security devices**

Biometric attendance Monitoring System, Working, Biometric Sensors, Home Automation System.

**UNIT - 6**

**Compliance:**

Product safety and liability issues, standards related to electrical safety and standards related to fire hazards, e.g., UL and VDE. EM1/EMC requirements and design techniques for compliance, e.g. ESD, RF interference and immunity, line current harmonics and mains voltage surge.

**TEXT/REFERENCE BOOKS**

1. Television & Video Engineering-A. M. Dhake, TMH Publication.
2. Monochrome and Color TV - R. R. Gulati, Wiley Eastern publication.
3. Video demystified -Keith Jack, PI publication
4. Audio & Video Systems-R.G.Gupta
5. Audio and Video system - Principles, maintenance and Troubleshooting by R. Gupta
6. Arora C. P., "Refrigeration and Air conditioning", Tata McGraw-Hill, New Delhi, 1994
7. Color TV Theory & Practice -S. P. Bali. TMG Hill Publication.
8. Basic TV & Video Systems-Bernard Grobb.
9. Electronic Communication Systems, Kennedy, TMH.
10. Principles of Communication Engineering- Anokh Singh-TMH.
11. C. M. Wintzer, International Commercial EMC Standards, Interference Control Technologies 1988.

12. P. A. Chatterton and M. A. Houlden, EMC: Electromagnetic Theory to Practical Design. Wiley, 1992.
13. J. A. S. Angus, Electronic Product Design, Chapman and Hall, 1996.
14. Y. J. Wind, Product Policy: Concepts, Methods, and Strategy, Addison-Wesley Pub. Co. 1982.

**BTETPE704B**

**Analog Integrated Circuit Design**

**3 Credits**

**Course Objectives:**

- Introduction to Circuit Simulation & EM Simulations.
- Deep Understanding of MOS Device Physics & Modeling.
- Understanding of few transistor circuits like common gate, common source & common drain amplifiers with their frequency response.
- Understanding of Operational Amplifier Design & Trade-offs.
- Advanced Op-Amps and OTAs.
- Temperature Compensated Biasing Schemes.

**Course Outcomes:**

After the successful completion of this course, Students will be able to:

1. Describe the models for active devices in MOS and Bipolar IC technologies.
2. Describe layout considerations for active and passive devices in analog ICs.
3. Analyze and design IC current sources and voltage references.
4. Describe the noise sources and models applicable to ICs.
5. Understand and appreciate the importance of noise and distortion in analog circuits.
6. Analyze integrated circuit noise performance.
7. Analyze and design IC operational amplifiers.

**UNIT - 1**

**Introduction to Simulations**

Introduction to Advanced Design System and Cadence Virtuoso, DC Simulations, AC Simulations, Harmonic Balance, Envelope Simulation, Electromagnetic Simulations- FEM, MOM, FDTD, Circuit Net listing.



**UNIT - 2**

**MOSFET Device Physics & Modeling**

MOSFET Structure, Threshold Voltage, Drain Current Equation, Transfer & Output Characteristics, Weak/Moderate/Strong Inversion, Linear/Triode/Saturation Region of Operation, Device Leakages and Losses, Short Channel Effects, High Frequency Small Signal Model of MOSFET, Cubic, BSIM and Materka Models of MOSFET.

**UNIT - 3**

**Few Transistor Circuits**

Current Mirrors, Common Source/Common Gate/Common Drain Amplifiers, Design and Analysis of CS/CG/CD Amplifiers, Cascode Amplifiers, Differential Gain Stage, Frequency Response & Design Trade-offs, Telescopic Cascode and Wide Swing Cascode Current Mirrors, PTAT, CTAT & Bandgap Bias Circuits.

**UNIT - 4**

**Operational Amplifiers & OTAs**

Design of Classical Op-Amps, Op-Amp Characteristics, Analysis and Trade-offs, Wideband Op-Amps, High Speed Op-Amps, Very High Gain Op-Amps, Operational Transconductance Amplifiers, Ultra Low Power OTAs for Medical Implants, Folded Cascode Op-Amps.

**UNIT - 5**

**Biasing Schemes**

Voltage and Current References,  $V_t$  reference bias, PTAT Current Reference, CTAT and Bandgap Voltage References, High Precision Voltage References, Voltage Level Shifters.

**UNIT - 6**

**Non-Linear Circuits**

Single and Balanced Diode Mixers, Translinear Cell, Gilbert Cell Mixers, Power Amplifiers, Even & Odd Order Mixing, In-Modulation (AM, PM Conversions) Distortions, Intermodulation Distortions, Intermodulation Products, ACPR & EVM.

**TEXT/REFERENCE BOOKS**

1. Tony Chan Carusone, David A. Johns, Kenneth W. Martin, "Analog Integrated Circuit

2. Design”, John Wiley & Sons
3. Keliu Shu, Edgar Sanchez-Sinencio, “CMOS PLL Synthesizers”, Springer
4. Jose Carlos Pedro, Nuno Borges Carvalho, “Intermodulation Distortion in Microwave and Wireless Circuits”, Artech House
5. Stephen A. Maas, “Microwave Mixers”, Artech House.

**BTETPE704C**

**Soft Computing**

**3 Credits**

**Course Objectives:**

- Introduce a relatively new computing paradigm for creating intelligent machines useful for solving complex real world problems.
- Insight into the tools that make up the soft computing technique: fuzzy logic, artificial neural networks and hybrid systems Techniques.
- To create awareness of the application areas of soft computing technique.
- Provide alternative solutions to the conventional problem solving techniques in image/signal processing, pattern recognition/classification, control system.

**Course Outcomes:**

After the successful completion of this course, students will be able to:

1. Use a new tool /tools to solve a wide variety of real world problems.
2. Find an alternate solution, which may offer more adaptability, resilience and optimization.
3. Identify the suitable antenna for a given communication system.
4. Gain knowledge of soft computing domain which opens up a whole new career option.
5. Tackle real world research problems.

**UNIT - 1**

**Artificial Neural Network –I:**

Biological neuron, Artificial neuron model, concept of bias and threshold, McCulloch- Pits Neuron Model, implementation of logical AND, OR, XOR functions Soft Topologies of neural networks, learning paradigms: supervised, unsupervised, reinforcement, Linear neuron model: concept of error energy, gradient descent algorithm and application of linear neuron for linear regression, Activation functions: binary, bipolar (linear, signup, log sigmoid, tan sigmoid) Learning mechanisms: Hebbian, Delta Rule o Perceptron and its limitations Draft.

UNIT - 2

**Artificial Neural Network-II:**

Multilayer perceptron (MLP) and back propagation algorithm o Application of MLP for classification and regression o Self-organizing Feature Maps, k- means clustering o Learning vector quantization Radial Basis Function networks: Cover's theorem, mapping functions(Gaussian, Multi-quadratics, Inverse multi quadratics, Application of RBFN for classification and regression o Hopfield network, associative memories.

UNIT - 3

**Fuzzy Logic –I:**

Concept of Fuzzy number, fuzzy set theory (continuous, discrete) o Operations on fuzzy sets, Fuzzy membership functions (core, boundary, and support), primary and composite linguistic terms, Concept of fuzzy relation, composition operation (T-norm,T-conorm) o Fuzzy if-then rules.

UNIT - 4

**Fuzzy Logic –II:**

Fuzzification, Membership Value Assignment techniques, De-fuzzification (Max membership principle, Centroid method, Weighted average method), Concept of fuzzy inference, Implication rules- Dienes-Rescher Implication, Mamdani Implication, Zadeh Implication, Fuzzy Inference systems -Mamdani fuzzy model, Sugeno fuzzy model , Tsukamoto fuzzy model, Implementation of a simple two-input single output FIS employing Mamdani model Computing.

UNIT - 5

**Fuzzy Control Systems:**

Control system design problem 1.5, Control (Decision) Surface, Assumptions in a Fuzzy Control System Design V, Fuzzy Logic Controllers Soft o Comparison with traditional PID control, advantages of FLC, Architecture of a FLC: Mamdani Type, Example Aircraft landing control problem.

UNIT - 6

**Adaptive Neuro-Fuzzy Inference Systems (ANFIS):**

ANFIS architecture, Hybrid Learning Algorithm, Advantages and Limitations of ANFIS  
Application of ANFIS/CANFIS for regression.

**TEXT/REFERENCE BOOKS**

1. Fundamentals of Neural Networks: Architectures, Algorithms and Applications, Laurene Fausett, Pearson Education, Inc, 2008.
2. Fuzzy Logic with Engineering Applications, Third Edition Thomas, Timothy Ross, John Wiley & Sons, 2010.
3. Neuro- Fuzzy and Soft Computing, J.S. Jang, C.T. Sun, E. Mizutani, PHI Learning Private Limited.
4. Principles of Soft Computing, S. N. Sivanandam, S. N. Deepa, John Wiley & Sons, 2007.
5. Introduction to the theory of neural computation, John Hertz, Anders Krogh, Richard Palmer, Addison –Wesley Publishing Company, 1991.
6. Neural Networks A comprehensive foundation,, Simon Haykin, Prentice Hall International Inc-1999.
7. Neural and Adaptive Systems: Fundamentals through Simulations, José C. Principe Neil R. Euliano, W. Curt Lefebvre, John-Wiley & Sons, 2000.
8. Pattern Classification, Peter E. Hart, David G. Stork Richard O. Duda, Second Edition, 2000.
9. Pattern Recognition, Sergios Theodoridis, Konstantinos Koutroumbas, Fourth Edition, Academic Press, 2008.
10. A First Course in Fuzzy Logic, Third Edition, Hung T. Nguyen, Elbert A. Walker, Taylor & Francis Group, LLC, 2008.
11. Introduction to Fuzzy Logic using MATLAB, S. N. Sivanandam, S. Sumathi, S. N. Deepa, Springer Verlag, 2007.

**BTETPE704D**

**Advance Industrial Automation-1**

**3 Credits**

**Course Objectives:**

- To identify potential areas for automation and justify need for automation.
- To select suitable major control components required to automate a process or an activity.

- To translate and simulate a real time activity using modern tools and discuss the benefits of automation.

**Course Outcomes:**

After the successful completion of this course, the student will be able:

1. To identify suitable automation hardware for the given application.
2. To recommend appropriate modeling and simulation tool for the given manufacturing application.

**UNIT - 1**

**Introduction:**

Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines. (SLE: Analysis of Transfer Lines).

**UNIT - 2**

**Material handling and Identification Technologies:**

Overview of Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods (SLE: Material Identification Methods).

**UNIT - 3**

**Automated Manufacturing Systems:**

Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Quality Control Systems: Traditional and Modern Quality Control Methods, SPC Tools, Inspection Principles and Practices, Inspection Technologies. (SLE: Usage of SPC tools using excel or Minitab).

**UNIT - 4**

**Control Technologies in Automation:**

Industrial Control Systems, Process Industries versus Discrete-Manufacturing Industries, Continuous Versus Discrete Control, Computer Process and its Forms, (SLE: Sensors, Actuators and other Control System Components).

**UNIT - 5**

**Computer Based Industrial Control:**

Introduction & Automatic Process Control, Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, SCADA Systems & RTU. Distributed Control System: Functional Requirements, Configurations & some popular Distributed Control Systems (SLE: Display Systems in Process Control Environment).

**UNIT - 6**

**Modeling and Simulation for Plant Automation:**

Introduction, need for system Modeling, Building Mathematical Model of a Plant, Modern Tools & Future Perspective. Industrial Control Applications: Cement, Thermal, Water Treatment & Steel Plants. (SLE: Cases Studies minimum one for Cement, Thermal, Water Treatment & Steel Plants applications).

**TEXT/REFERENCE BOOKS**

1. Automation, Production Systems and Computer Integrated Manufacturing- M.P.Groover, Pearson Education.5th edition, 2009.
2. Computer Based Industrial Control- Krishna Kant, EEE-PHI,2nd edition,2010
3. An Introduction to Automated Process Planning Systems- Tiess Chiu Chang & Richard A. Wysk.
4. Performance Modeling of Automated Manufacturing Systems,-Viswanandham, PHI, 1st edition, 2009.

**BTETPE704E**

**Mechatronics**

**3 Credits**

**Course Objectives:**

- Understand key elements of Mechatronics system, representation into block diagram.
- Understand concept of transfer function, reduction and analysis.
- Understand principles of sensors, its characteristics, interfacing with DAQ microcontroller.

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- Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application.
- Understand the system modelling and analysis in time domain and frequency domain.
- Understand control actions such as Proportional, derivative and integral and study its significance in industrial applications.

### **Course Outcomes:**

1. Identification of key elements of mechatronics system and its representation in terms of block diagram.
2. Understanding the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O.
3. Interfacing of Sensors, Actuators using appropriate DAQ micro-controller.
4. Time and Frequency domain analysis of system model (for control application).
5. PID control implementation on real time systems.
6. Development of PLC ladder programming and implementation of real life system.

### **UNIT - 1**

#### **Introduction to Sensors & Actuators**

Introduction to Mechatronics, Measurement characteristics: -Static and Dynamic Sensors: Position Sensors: -Potentiometer, LVDT, Encoders; Proximity sensors:-Optical, Inductive, Capacitive; Motion Sensors:-Variable Reluctance; Temperature Sensor: RTD, Thermocouples; Force / Pressure Sensors:-Strain gauges; Flow sensors: -Electromagnetic Actuators: Stepper motor, Servo motor, Solenoids.

### **UNIT - 2**

#### **Block Diagram Representation**

Open and Closed loop control system, identification of key elements of mechatronics systems and represent into block diagram (Electro-Mechanical Systems), Concept of transfer function, Block diagram reduction principles, Applications of mechatronics systems:-Household, Automotive, Shop floor (industrial).

**UNIT - 3**

**Data Acquisition & Microcontroller System**

Interfacing of Sensors / Actuators to DAQ system, Bit width, Sampling theorem, Aliasing, Sample and hold circuit, Sampling frequency, ADC (Successive Approximation), DAC (R-2R), Current and Voltage Amplifier.

**UNIT - 4**

**PLC**

Programming Introduction, Architecture, Ladder Logic programming for different types of logic gates, Latching, Timers, Counter, Practical Examples of Ladder Programming, and Introduction to SCADA system.

**UNIT - 5**

**Modelling and Analysis of Mechatronics System**

System modelling (Mechanical, Thermal and Fluid), Stability Analysis via identification of poles and zeros, Time Domain Analysis of System and estimation of Transient characteristics: % Overshoot, damping factor, damping frequency, Rise time, Frequency Domain Analysis of System and Estimation of frequency domain parameters such as Natural Frequency, Damping Frequency and Damping Factor.

**UNIT - 6**

**Control System**

P, I and D control actions, P, PI, PD and PID control systems, Transient response:-Percentage overshoot, Rise time, Delay time, Steady state error, PID tuning (manual).

**TEXT/REFERENCE BOOKS**

1. K.P. Ramchandran, G.K. Vijayaraghavan, M.S. Balasundaram, Mechatronics: Integrated Mechanical Electronic Systems, Willey Publication, 2008
2. Bolton, Mechatronics -A Multidisciplinary approach, 4th Edition, Prentice Hall, 2009.
3. Alciatore & Histan, Introduction to Mechatronics and Measurement system, 4th Edition, McGraw Hill publication, 2011.
4. Bishop (Editor), Mechatronics –An Introduction, CRC Press, 2006.
5. Mahalik, Mechatronics –Principles, concepts and applications, Tata Mc - Graw Hill publication, New Delhi.



6. C. D. Johnson, Process Control Instrumentation Technology, Prentice Hall, New Delhi.

**BTETPE704F**

**Electronics in Smart City**

**3 Credits**

**Course Objectives:**

**Course Outcomes:**

**UNIT - 1**

**Necessity of SMART CITY**

The Smart City Philosophy, Development of Asian Cities, Megacities of India: Current Challenges, The India Story of Smart Cities, Conceptual Basis of a Smart City, Global Smart City Programs, Recommendations for Smart City Framework in GCC.

**UNIT - 2**

**SMART CITY and IOT**

Introduction to Internet of Things, applications in smart city & their distinctive advantages - smart environment, smart street light and smart water & waste management. What is an IOT? Role and scope of IOT in present and future marketplace.

**UNIT - 3**

**SMART Objects**

Smart objects, Wired – Cables, hubs, etc., Wireless – RFID, WiFi, Bluetooth, etc. Different functional building blocks of IOT architecture

**UNIT - 4**

**Smart Cities: Distributed Intelligence and Central Planning**

On the Interplay between Humans and Smart Devices, Theoretical Tools, Intelligence-Artificial Intelligence (Machine Intelligence), Information Dynamics, Synergetic, Information Dynamics and Allometry in Smart Cities.

**UNIT - 5**

**Wireless Protocols for Smart Cities**

IPv6 over Low-Power Wireless Personal Area Network: Features, Addressing, Packet fragmentation, Operation, Security. ZigBee: Architecture Objectives, Wireless Networking

Basics, Wireless Networking Assumptions, Bluetooth Low Energy, Constrained Application Protocol, Message Queue Telemetry Protocol.

**UNIT - 6**

**Leveraging Smart City Projects for Benefitting Citizens: The Role of ICTs**

Smart City and ICT: Using Technologies to Improve the Citizens' Quality of Life, Smart City Goals: The Impact on Citizens' Well-Being and Quality of Life, Critical Dimensions: Urbanization, Local Climate Change, and Energy Poverty, Environmental Issues: The Role of Local and Global Climate Chang.

**TEXT/REFERENCE BOOKS**

**Dr. Babasaheb Ambedkar Technological University, Lonere.**

**BTHM705**

**Financial Management**

**2 Credits**

**Course Objectives:**

- To help the students to develop cognizance of the importance of Financial Management in corporate valuation
- To enable students to describe how people analyze the corporate leverage under different conditions and understand why people value different corporates in different manner.
- To provide the students to analyze specific characteristics of Supply Chain Industry and their future action for cash flow
- To enable students to synthesize related information and evaluate options for most logical and optimal solution such that they would be able to predict and control Debt Equity incurrence and improve results.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

1. The students would be able to understand and define basic terminology used in finance and accounts
2. The students would be able to prepare & appraise Financial Statements and evaluate a company in the light of different measurement systems.
3. The students would be able to analyze the risk and return of alternative sources of financing.
4. Estimate cash flows from a project, including operating, net working capital, and capital spending.
5. To estimate the required return on projects of differing risk, to estimate the cash flows from an investment project, calculate the appropriate discount rate, determine the value added from the project, and make a recommendation to accept or reject the project
6. To describe and illustrate the important elements in project finance Using financial calculator and Excel in a variety of problems.

## UNIT - 1

**Introduction to Financial Accounting, Book keeping & Recording:** Meaning, Scope and importance of Financial Accounting. Financial Accounting - concepts and conventions, classification of accounts, Rules and principles governing Double Entry Book-keeping system, Meaning, Preparation of Journal, Ledger , Cash book & Trial balance.

## UNIT - 2

**Financial Statement Preparation, analysis & Interpretation:** Preparation of financial statement and Profit & Loss Account, Balance Sheet. , Ratio Analysis - classification of various ratios.

## UNIT - 3

**Introduction To Financial Management:** Concept of business finance, Goals & objectives of financial management, Sources of financing, Long Term financing- shares, debentures, term loans, lease & hire purchase, retained earnings, public deposits, bonds (Types, features & utility). Short Term Financing- bank finance, commercial paper, trade credit

## UNIT - 4

**Working Capital Management:** Concept of working Capital, significance, types. Adequacy of working capital, Factors affecting working capital needs, financing approaches for working capital, Methods of forecasting working capital requirements, Methods of Forecasting.

## UNIT - 5

**Time Value of Money & Capital Budgeting:** Concept of time value of money, Compounding & discounting; Future value of single amount & annuity, present value of single amount & annuity; Practical application of time value technique. Capital budgeting - Nature and significance, techniques of capital budgeting –Pay Back Method, Accounting rate of return, Internal Rate of Return, DCF, Net Present Value and profitability index.

## UNIT - 6

**Project Financing:** Details of the company, its promoters and project finances required, profitability etc., Loan documentation-Appraisal of terms loans by financial institutions. Basic components of project finance.

### TEXT & REFERENCE BOOKS

1. Financial Management by Khan & Jain, Text, Problem & Cases, Tata McGraw Hill Publication 5<sup>th</sup> Edition.
2. Tulsian Financial Management by Dr. P.C.Tulsian, S Chand Publication 5<sup>th</sup> Edition.
3. Taxman's Financial Management by Ravi M. Kishore, Taxmann 2017 Edition.
4. A Textbook of Financial , Cost & Management Accounting by Dr.P.Pariasamy, Himalaya Publishing House
5. Fundamentals of financial Management by Bhabhtosh Banerjee, PHI publication, 2<sup>nd</sup> Edition.

**PROF. SUDIP MISRA Dept. of Computer Science and Engineering IIT Kharagpur**

**Course Duration: 12 week**

**Course Outline:**

Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defence sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different IoT solutions. IoT-based applications such as innovative shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT based systems. Therefore, it is very important to learn the fundamentals of this emerging technology.

**Course Plan:**

Week 01 : Introduction to IoT, Sensing, Actuation, Basics of Networking.

Week 02 : Basics of Networking, Communication Protocols.

Week 03 : Communication Protocols, Sensor Networks

Week 04 : Sensor Networks, Machine-to-Machine Communications.

Week 05 : Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino.

Week 06 : Introduction to Python programming, Introduction to Raspberry.

Week 07 : Implementation of IoT with Raspberry Pi, Introduction to SDN.

Week 08 : SDN for IoT, Data Handling and Analytics, Cloud Computing

Week 09 : Cloud Computing, Sensor-Cloud.

Week 10 : Fog Computing, Smart Cities and Smart Homes

Week 11 : Connected Vehicles, Smart Grid, Industrial IoT

Week 12 : Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring

**Dr. M. K. Bhuyan**

**Professor, Indian Institute of Technology Guwahati,**

**Course Duration: 12 week**

**Course Outline:**

The course familiarizes students with fundamental concepts and issues related to computer vision and major approaches that address them. The focus of the course is on image acquisition and image formation models, radiometric models of image formation, image formation in the camera, image processing concepts, concept of feature extraction and feature selection for pattern classification/recognition, and advanced concepts like object classification, object tracking, image-based rendering, and image registration. Intended to be a companion to a typical teaching course on computer vision, the course takes a problem-solving approach

**Course Plan:**

**I Image Formation and Image Processing**

Introduction to Computer Vision and Basic Concepts of Image Formation

Introduction and Goals of Computer Vision, Image Formation and Radiometry, Geometric Transformation, Geometric Camera Models, Image Reconstruction from a Series of Projections

Image Processing Concepts

Fundamentals of Image Processing, Image Transforms, Image Filtering, Colour Image Processing, Mathematical Morphology, Image Segmentation

**II Image Features**

Image Descriptors and Features

Texture Descriptors, Colour Features, Edge Detection, Object Boundary and Shape Representations, Interest or Corner Point Detectors, Histogram of Oriented Gradients (HOG), Scale Invariant Feature Transform (SIFT), Speeded up Robust Features (SURF), Saliency

**III Recognition**

Fundamental Pattern Recognition Concepts

Introduction to Pattern Recognition, Linear Regression, Basic Concepts of Decision Functions, Elementary Statistical Decision Theory, Gaussian Classifier, Parameter Estimation, Clustering for Knowledge Representation, Dimension Reduction, Template Matching, Artificial Neural Network (ANN) for Pattern Classification, Convolutional Neural Networks (CNNs), Autoencoder

**IV Applications**

Applications of Computer Vision

Machine Learning Algorithms and their Applications in Medical Image Segmentation, Motion Estimation and Object Tracking, Face and Facial Expression Recognition, Gesture Recognition, Image Fusion, Programming Examples

Prof. Sudipta Mukhopadhyay, IIT Kharagpur

Course Duration: 12 week

**Course outline:**

This course is prepared for the engineering students in their final year of undergraduate studies or in their graduate studies. Electrical Engineering students with a good background in Signals and Systems are prepared to take this course. Students in other engineering disciplines, or in computer science, mathematics, geo physics or physics should also be able to follow this course. While a course in Digital Signal Processing would be useful, it is not necessary for a capable student. The course has followed problem solving approach as engineers are known as problem solvers. The entire course is presented in the form of series of problems and solutions.

**Course Plan:**

Week 1: Preliminaries; Biomedical signal origin & dynamics (ECG)

Week 2: Biomedical signal origin & dynamics (EEG, EMG etc.)

Week 3: Filtering for Removal of artifacts Statistical Preliminaries; Time domain filtering (Synchronized Averaging, Moving Average)

Week 4: Filtering for Removal of artifacts contd. Time domain filtering (Moving Average Filter to Integration, Derivative-based operator), Frequency Domain Filtering (Notch Filter)

Week 5: Filtering for Removal of artifacts contd. Optimal Filtering: The Weiner Filter

Week 6: Filtering for Removal of artifacts contd. Adaptive Filtering Selecting Appropriate Filter

Week 7: Event Detection Example events (viz. P, QRS and T wave in ECG) Derivative based Approaches for QRS Detection Pan Tompkins Algorithm for QRS Detection

Week 8: Event Detection contd. Dicrotic Notch Detection Correlation Analysis of EEG Signal

Week 9: Waveform Analysis Illustrations of problem with case studies Morphological Analysis of ECG Correlation coefficient The Minimum phase correspondent and Signal Length

Week 10: Waveform Analysis contd. Envelop Extraction Amplitude demodulation The Envelopgram Analysis of activity Root Mean Square value Zero-crossing rate Turns Count, Form factor

Week 11: Frequency-domain Analysis Periodogram

Week 12: Frequency-domain Analysis Averaged Periodogram Blackman-Tukey Spectral Estimator Daniell's Spectral Estimator Measures derived from PSD



**Prof. S. Mukhopadhyay Department of Electrical Engineering IIT Kharagpur**

**Course Duration: 12 week**

**Course Plan:**

Week 1: Introduction to Industrial Automation and Control , Architecture of Industrial Automation Systems, Introduction to sensors and measurement systems

Week 2: Temperature measurement, Pressure and Force measurements, Displacement and speed measurement, Flow measurement techniques , Measurement of level, humidity, pH etc

Week 3: Signal Conditioning and Processing, Estimation of errors and Calibration

Week 4: Introduction to Process Control, P-- I -- D Control, Controller Tuning.

Week 5: Implementation of PID Controllers, Special Control Structures : Feedforward and Ratio Control. Predictive Control, Control of Systems with Inverse Response, Cascade Control, Overriding Control, Selective Control, Split Range Control

Week 6: Introduction to Sequence Control, PLCs and Relay Ladder Logic Sequence Control : Scan Cycle, RLL Syntax , Structured Design Approach

Week 7: Sequence Control : Advanced RLL Programming ,The Hardware environment

Week 8 : Control of Machine tools : Introduction to CNC Machines , Analysis of a control loop

Week 9 : Introduction to Actuators : Flow Control Valves , Hydraulic Actuator Systems : Principles, Components and Symbols , Pumps and Motors, Proportional and Servo Valves

Week 10 : Pneumatic Control Systems : System Components , Controllers and Integrated Control Systems, Electric Drives : Introduction, Energy Saving with Adjustable Speed Drives , Step motors : Principles, Construction and Drives

Week 11: DC Motor Drives: Introduction, DC--DC Converters, Adjustable Speed Drives , Induction Motor Drives: Introduction, Characteristics, Adjustable Speed Drives ,Synchronous Motor Drives : Motor Principles, Adjustable Speed and Servo Drives

Week 12: Networking of Sensors, Actuators and Controllers : The Fieldbus ,The Fieldbus Communication Protocol , Introduction to Production Control Systems

Dr. Debdeep Mukhopadhyay IIT Kharagpur

Course Duration: 12 week

### Course Outline

The course deals with the underlying principles of cryptography and network security. It develops the mathematical tools required to understand the topic of cryptography. Starting from the classical ciphers to modern day ciphers, the course provides an extensive coverage of the techniques and methods needed for the proper functioning of the ciphers. The course deals with the construction and cryptanalysis of block ciphers, stream ciphers and hash functions. The course defines one way functions and trap-door functions and presents the construction and cryptanalysis of public key ciphers, namely RSA. The key exchange problem and solutions using the DiffieHellman algorithm are discussed. Message Authentication Codes (MAC) and signature schemes are also detailed. The course deals with modern trends in asymmetric key cryptography, namely using Elliptic Curves. The course concludes with the design rationale of network protocols for key exchange and attacks on such protocols

### Course Plan:

#### Introduction and Mathematical Foundations

Introduction, Overview on Modern Cryptography, Number Theory, Probability and Information Theory

#### Classical Cryptosystems

Classical Cryptosystems, Cryptanalysis of Classical Cryptosystems, Shannon's Theory

#### Symmetric Key Ciphers

Symmetric Key, Ciphers Modern Block Ciphers (DES), Modern Block Cipher (AES)

#### Cryptanalysis of Symmetric Key Ciphers

Linear Cryptanalysis, Differential Cryptanalysis, Other Cryptanalytic Techniques, Overview on S-Box Design Principles, Modes of operation of Block Ciphers

#### Stream Ciphers and Pseudo-randomness

Stream Ciphers, Pseudorandom functions

#### Hash Functions and MACs

Hash functions: The Merkle Damgard Construction, Message Authentication Codes (MACs)

#### Asymmetric Key Ciphers: Construction and Cryptanalysis

More Number Theoretic Results ,The RSA Cryptosystem, Primality Testing, Factoring Algorithms , Other attacks on RSA and Semantic Security of RSA ,The Discrete Logarithm Problem (DLP) and the Diffie Hellman Key Exchange algorithm, The ElGamal Encryption Algorithm Cryptanalysis of DLP

#### Digital Signatures

Signature schemes

**Modern Trends in Asymmetric Key Cryptography**

Elliptic curve based cryptography

**Network Security**

Secret Sharing Schemes, A Tutorial on Network Protocols, Kerberos, Pretty Good Privacy (PGP) Secure Socket Layer (SSL), Intruders and Viruses, Firewalls

**BTETPE 802C**

**Digital IC Design**

**4 credits**

**PROF. JANAKIRAMAN Electrical and Electronics Engineering IIT Madras**

**Course Duration : 12 weeks**

**Course Outline:** This is a most fundamental Digital Circuit Design course for pursuing a major in VLSI. We do not deal with any Verilog coding during this course and instead discuss transistor level circuit design concepts in great detail.

Learning objectives of this course are:

- Characterize the key delay quantities of a standard cell
- Evaluate power dissipated in a circuit (dynamic and leakage)
- Design a circuit to perform a certain functionality with specified speed
- Identify the critical path of a combinational circuit
- Convert the combinational block to pipelined circuit
- Calculate the maximum (worst case) operating frequency of the designed circuit

**Course Plan:**

Week 1: The CMOS Inverter construction and Voltage Transfer Characteristics

Week 2: Resistance and Capacitance and transient response.

Week 3: Dynamic, Short Circuit and Leakage power – Stacking Effect

Week 4: Combinational Circuit Design and capacitance

Week 5: Parasitic Delay, Logical Effort and Electrical Effort

Week 6: Gate sizing and Buffering

Week 7: Asymmetric gate, Skewed gates, Ratio'ed logic

Week 8: Dynamic Gates and Domino logic and Static Timing Analysis

Week 9: Sequential circuits and feedback. Various D flip flop circuits – Static and Dynamic

Week 10: Setup and Hold Time measurement. Timing analysis of latch/ flop based systems

Week 11: Adders – Mirror adder, Carry Skip adder, Carry Select adder, Square Root adder

Week 12: Multipliers – Signed and Unsigned arithmetic, Carry Save Multiplier implementation