

Dr. Babasaheb Ambedkar Technological University, Lonere.

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

S.N.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTEXC701	Professional Core Course 1	Antennas and Wave Propagation	3	0	0	20	20	60	100	3
2	BTEXPE702	Program Elective 3	Group A	3	0	0	20	20	60	100	3
3	BTEXPE703	Program Elective 4	Group B	3	0	0	20	20	60	100	3
4	BTEXPE704	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	--	50	--	50	2
6	BTEXL706	Program Elective 3 Lab		0	0	2	--	30	20	50	1
7	BTEXL707	Program Elective 4 Lab		0	0	2	--	30	20	50	1
8	BTEXL708	Program Elective 5 Lab		0	0	2	--	30	20	50	1
9	BTEXP709	Project Part-I		0	0	8	--	50	50	100	4
10	BTEXS710	Seminar		0	0	2	--	30	20	50	1
11	BTEXF612	Field Training/ Internship/Industrial Training Evaluation		--	--	--	--	--	50	50	1
Total				14	0	16	80	300	420	800	23

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Program Elective 3 (Group A)	Program Elective 4 (Group B)	Program Elective 5 (Group C)
(A) Digital Image Processing	(A) IOT 4.0	(A) Microwave Theory & Techniques
(B) Data Compression and Encryption /Cryptography	(B) Wireless Sensor Networks	(B) Satellite Communication
(C) NSQF (Level 7 Course)	(C) CMOS Design	(C) Fiber Optic Communication
(D) Parallel Processing	(D) Process Instrumentation	(D) Wireless Communication

B. Tech (Electronics 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"> Introduction to Internet of Things Computer Vision and Image Processing Biomedical Signal Processing Industrial Automation and Control Cryptography and Network Security Digital IC Design # Student to opt any two subjects from above list	3	-	--	20*	20*	60*	100	3
			3	-	--	20*	20*	60*	100	3
BTMEP803	Project Part-II or Internship*		--	--	30	--	--	100	150	15
Total			--	--				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

Course Objectives:

- To understand the applications of electromagnetic engineering.
- To formulate and solve the Helmholtz wave equation and solve it for Uniform Plane Wave.
- To analyze and understand the Uniform plane wave propagation in various media.
- To solve the electric field and magnetic fields for a given wire antenna.

Course Outcomes:

After successfully completing the course students will be able to

1. Formulate the wave equation and solve it for uniform plane wave.
2. Analyze the given wire antenna and its radiation characteristics.
3. Identify the suitable antenna for a given communication system.

UNIT - 1

Uniform Plane Waves

Maxwell Equations in phasor form, Wave Equation, Uniform Plane wave in Homogeneous, free space, dielectric, conducting medium. Polarization: Linear, circular & Elliptical polarization, unpolarized wave. Reflection of plane waves, Normal incidence, oblique incidence, Electromagnetic Power and Poynting theorem and vector.

UNIT - 2

Wave Propagation

Fundamental equations for free space propagation, Friis Transmission equation, Attenuation over reflecting surface, Effect of earth's curvature. Ground, sky & space wave propagations. Structure of atmosphere. Characteristics of ionized regions. Effects of earth's magnetic field. Virtual height, MUF, Skip distance. Ionospheric abnormalities. Multi-hop propagation. Space link geometry. Characteristics of Wireless Channel: Fading, Multipath delay spread, Coherence Bandwidth, and Coherence Time.

UNIT - 3

Antenna Fundamentals

Introduction, Types of Antenna, Radiation Mechanism, Antenna Terminology: Radiation pattern, radiation power density, radiation intensity, directivity, gain, antenna efficiency, half power beam width, bandwidth, antenna polarization, input impedance, antenna radiation

efficiency, effective length, effective area, reciprocity. Radiation Integrals: Vector potentials A, J, F, M, Electric and magnetic fields electric and magnetic current sources, solution of inhomogeneous vector potential wave equation, far field radiation.

UNIT - 4

Wire Antennas

Analysis of Linear and Loop antennas: Infinitesimal dipole, small dipole, and finite length dipole half wave length dipole, small circular loop antenna. Complete Analytical treatment of all these elements.

UNIT - 5

Antenna Arrays

Antenna Arrays: Two element array, pattern multiplication N-element linear array, uniform amplitude and spacing, broad side and end-fire array, N-element array: Uniform spacing, nonuniform amplitude, array factor, binomial and Dolph Tchebyshev array. Planar Array, Circular Array, Log Periodic Antenna, Yagi Uda Antenna Array.

UNIT - 6

Antennas and Applications

Structural details, dimensions, radiation pattern, specifications, features and applications of following Antennas: Hertz & Marconi antennas, V- Antenna, Rhombic antenna. TW antennas. Loop antenna, Whip antenna, Biconical, Helical, Horn, Slot, Microstrip, Turnstile, Super turnstile & Lens antennas. Antennas with parabolic reflectors.

TEXT/REFERENCE BOOKS

1. C. A. Balanis, "Antenna Theory - Analysis and Design", John Wiley.
2. Mathew N O Sadiku, "Elements of Electromagnetics" 3rd edition, Oxford University Press.
3. John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas for All Applications, 3rd Edition, the McGraw Hill Companies.
4. K. D. Prasad, "Antenna & Wave Propagation", Satya Prakashan, New Delhi.
5. John D Kraus, "Antenna & Wave Propagation", 4th Edition, McGraw Hill, 2010.
6. Vijay K Garg, Wireless Communications and Networking, Morgan Kaufmann Publishers, An Imprint of Elsevier, 2008.

BTEXPE702A

Digital Image Processing

3 Credits

Course Objectives:

- To learn the fundamental concepts of Digital Image Processing.
- To study basic image processing operations.
- To understand image analysis algorithms.
- To expose students to current applications in the field of digital image processing.

Course Outcomes:

After successfully completing the course students will be able to

1. Develop and implement algorithms for digital image processing.
2. Apply image processing algorithms for practical object recognition applications.

UNIT - 1

Fundamentals of Image Processing

Steps in image processing, Human Visual System, Sampling & quantization, Representing digital images, Spatial & gray-level resolution, Image file formats, Basic relationships between pixels, Distance Measures, Basic operations on images-image addition, subtraction, logical operations, scaling, translation, rotation, Image Histogram, Color fundamentals & models – RGB, HSI YIQ.

UNIT - 2

Image Enhancement and Restoration

Spatial domain enhancement: Point operations-Log transformation, Power-law transformation, Piecewise linear transformations, Histogram equalization. Filtering operations- Image smoothing, Image sharpening. Frequency domain enhancement: 2D DFT, Smoothing and Sharpening in frequency domain. Homomorphic filtering. Restoration: Noise models, Restoration using Inverse filtering and Wiener filtering.

UNIT - 3

Image Compression

Types of redundancy, Fidelity criteria, Lossless compression – Runlength coding, Huffman coding, Bit-plane coding, Arithmetic coding, Introduction to DCT, Wavelet transform. Lossy compression – DCT based compression, Wavelet based compression. Image and Video Compression Standards – JPEG, MPEG

UNIT - 4

Image Segmentation and Morphological Operations

Image Segmentation: Point Detections, Line detection, Edge Detection-First order derivative –Prewitt and Sobel, Second order derivative – LoG, DoG, Canny, Edge linking, Hough Transform, Thresholding – Global, Adaptive. Otsu’s Method, Region Growing, Region Splitting and Merging, Morphological Operations: Dilation, Erosion, Opening, Closing, Hit-or-Miss transform, Boundary Detection, Thinning, Thickening, Skeleton.

UNIT - 5

Representation and Description

Representation – Chain codes, Polygonal approximation, Signatures. Boundary Descriptors – Shape numbers, Fourier Descriptors, Statistical moments. Regional Descriptors – Topological, Texture, Principal Components for Description.

UNIT - 6

Object Recognition and Applications

Feature extraction, Patterns and Pattern Classes, Representation of Pattern classes, Types of classification algorithms, Minimum distance classifier, Correlation based classifier, Bayes classifier. Applications: Biometric Authentication, Character Recognition, Content based Image Retrieval, Remote Sensing, Medical application of Image processing.

TEXT/REFERENCE BOOKS

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Third Edition, - Pearson Education.
2. S Sridhar, “Digital Image Processing”, Oxford University Press.
3. Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, “Digital Image Processing Using MATLAB”, Second Edition, - Tata McGraw Hill Publication.
4. S Jayaraman, S Esakkirajan, T Veerakumar, “Digital Image Processing”, Tata Mc Graw Hill Publication

Course Objectives:

- To teach the students Lossless and Lossy compression techniques for different types of data.
- To understand data encryption techniques.
- Network security and ethical hacking.

Course Outcomes:

After successfully completion of the course, students will able to:

1. Implement text, audio and video compression techniques.
2. Understand symmetric and asymmetric key cryptography schemes.
3. Understand network security and ethical hacking.

UNIT - 1

Data Compression

Compression Techniques: Loss less compression, Lossy compression, measure of performance, modeling and coding, different types of models, and coding techniques
Text Compression: Minimum variance Huffman coding, extended Huffman coding, Adaptive Huffman coding. Arithmetic coding, Dictionary coding techniques, LZ 77, LZ 78, LZW

UNIT - 2

Audio Compression

High quality digital audio, frequency and temporal masking, lossy sound compression, μ -law and A-law companding, and MP3 audio standard.

UNIT - 3

Image and Video Compression

PCM, DPCM JPEG, JPEG –LS, and JPEG 2000 standards, Intra frame coding, motion estimation and compensation, introduction to MPEG -2 H-264 encoder and decoder.

UNIT - 4

Data Security

Security goals, cryptography, steganography cryptographic attacks, services and mechanics, Integer arithmetic, modular arithmetic, and linear congruence, Substitution cipher,

transposition cipher, stream and block cipher, and arithmetic modes for block ciphers, Data encryption standard, double DES, triple DES, attacks on DES, AES, key distribution center.

UNIT - 5

Number Theory and Asymmetric Key Cryptography

Primes, factorization, Fermat's little theorem, Euler's theorem, and extended Euclidean algorithm, RSA, attacks on RSA, Diffie Hellman key exchange, key management, and basics of elliptical curve cryptography, Message integrity, message authentication, MAC, hash function, H MAC, and digital signature algorithm.

UNIT - 6

System Security

Malware, Intruders, Intrusion detection system, firewall design, antivirus techniques, digital Immune systems, biometric authentication, and ethical hacking.

TEXT/REFERENCE BOOKS

1. Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann, 2000.
2. David Saloman, Data Compression: The complete reference, Springer publication.
3. Behrouz Forouzen, —Cryptography and Network Security, Tata McGraw–Hill Education 2011.
4. Berard Menezes, Network Security and Cryptography, learning publication Cengage.
5. William Stallings, Cryptography and Network Security, Pearson Education Asia Publication, 5th edition.

Course Objectives:

- Learn the concepts of parallel processing as it pertains to high-performance computing.
- Learn to design parallel programs on high performance computing.
- Discuss issues of parallel programming.
- Learn the concepts of message passing paradigm using open source APIs.
- Learn different open source tools.
- Learn the concepts of Multi-core processor

Course Outcomes:

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

1. Describe different parallel processing platforms involved in achieving High
2. Performance Computing.
3. Discuss different design issues in parallel programming
4. Develop efficient and high performance parallel programming
5. Learn parallel programming using message passing paradigm using open source MPIs.
6. Design algorithms suited for Multicore processor and GPU systems using Open MP and CUDA.

UNIT - 1

Parallel Programming Platforms

Implicit Parallelism: Trends in Microprocessor Architectures ,Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques.

UNIT - 2

Principles of Parallel Algorithm Design algorithms

Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models.

UNIT - 3

Basic Communication Operations and algorithms

One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.

UNIT - 4

Analytical Modeling of Parallel Programs

Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, Effect of Granularity and Data Mapping on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs, Other Scalability Metrics.

UNIT - 5

Programming Using the Message Passing Paradigm

Principles of Message-Passing Programming, the Building Blocks: Send and Receive Operations, MPI: The Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators

UNIT - 6

Programming Shared Address Space Platforms Thread Basics

Threads, the POSIX Thread Application Programmer Interface, Synchronization Primitives in POSIX, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs.

TEXT/REFERENCE BOOKS

1. Introduction to parallel programming, Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Pearson Publication.
2. Introduction to Parallel Processing, M. SasiKumar, Dinesh Shikhare P.Raviprakash, PHI Publication.

BTEXPE703A

IoT 4.0

3 Credits

Course Objectives:

- Students will be explored to the interconnection and integration of the physical world and the cyber space.
- To provide ability to design and develop IOT devices.

Course Outcomes:

1. Learner will be able to understand the meaning of internet in general and IOT in terms of layers, protocols, packets peer to peer communication
2. Learner will be able to interpret IOT working at transport layer with the help of various protocols.
3. Learner will be able to understand IOT concept at data link layer.
4. Learner will be able to apply the concept of mobile networking to the internet connected devices.
5. Learner will be able to measure and schedule the performance of networked devices in IOT.
6. Learner will be able to analyze the challenges involve in developing IOT architecture.

UNIT - 1

Introduction

What is the Internet of Things: History of IoT, about objects/things in the IoT, Overview and motivations, Examples of applications, IoT definitions, IoT Frame work, General observations, ITU-T views, working definitions, and basic nodal capabilities.

UNIT - 2

Fundamental IoT Mechanisms & Key Technologies:

Identification of IoT objects and services, Structural aspects of the IoT, Environment characteristics, Traffic characteristics ,scalability, Interoperability, Security and Privacy, Open architecture, Key IoT Technologies ,Device Intelligence, Communication capabilities, Mobility support, Device Power, Sensor Technology, RFID technology, Satellite Technology.

UNIT - 3

Radio Frequency Identification Technology:

Introduction, Principles of RFID, Components of an RFID system, Reader, RFID tags, RFID middleware, Issue. Wireless Sensor Networks: History and context, node, connecting nodes, networking nodes, securing communication.

UNIT - 4

Wireless Technologies For IoT : Layer ½ Connectivity :

WPAN Technologies for IoT/M2M, Zigbee /IEEE 802.15.4, Radio Frequency for consumer Electronics (RF4CE), Bluetooth and its low-energy profile , IEEE 802.15.6 WBANS, IEEE 802.15 WPAN TG4j, MBANS, NFC, dedicated short range communication(DSRC) & related protocols. Comparison of WPAN technologies cellular & mobile network technologies for IoT/M2M.

UNIT - 5

Governance of The Internet of Things:

Introduction, Notion of governance, aspects of governance, Aspects of governance Bodies subject to governing principles, private organizations, International regulation and supervisor, substantive principles for IoT governance, Legitimacy and inclusion of stakeholders, transparency, accountability. IoT infrastructure governance, robustness, availability, reliability, interoperability, access. Future governance issues, practical implications, legal implications.

TEXT/REFERENCE BOOKS

1. Hakima Chaouchi, The Internet of Things, Connecting Objects to the Web, Wiley Publications
2. Daniel Minoli, Building the Internet of Things with IPv6 and MIPv6 The Evolving World of M2M Communications, Wiley Publications
3. Bernd Scholz-Reiter, Florian Michahelles, Architecting the Internet of Things, ISBN 978-3842-19156-5, Springer.

4. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things Key Applications and Protocols, ISBN 978-1-119-99435-0, Wiley Publications.

BTEXPE703B

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 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. Walteneus 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 "TinyOS Programming” by Cambridge University Press 2009

BTEXPE703C

CMOS Design

3 Credits

Course Objectives:

- To develop an understanding of design different CMOS circuits using various logic families along with their circuit layout.
- To introduce the student how to use tools for VLSI IC design.

Course Outcomes:

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

1. Design different CMOS circuits using various logic families along with their circuit layout.
2. Use tools for VLSI IC design.

UNIT - 1

Review of MOS transistor models, Non-ideal behavior of the MOS Transistor, Transistor as a switch, Inverter characteristics.

UNIT - 2

Integrated Circuit Layout: Design Rules, Parasitics

UNIT - 3

Delay: RC Delay model, linear delay model, logical path efforts

UNIT - 4

Power, interconnect and Robustness in CMOS circuit layout

UNIT - 5

Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic

UNIT - 6

Sequential Circuit Design: Static circuits, Design of latches and Flip-flops.

TEXT/REFERENCE BOOKS

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th Edition, Pearson Education India, 2011.
2. C. Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.
3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.
4. P. Douglas, VHDL: programming by example, McGraw Hill, 2013.
5. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985

BTEXPE703D

Process Instrumentation

3 Credits

Course Objectives:

Course Outcomes:

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

1. Understand various processes.
2. Develop Instrumentation for these processes.

3. Apply the control strategies for various process applications.
4. Mapping with PEOs.

UNIT - 1

Instrumentation for heat exchangers and dryers

Operation of heat exchanger, controlled and manipulated variables in heat exchanger control problem, instrumentation for feedback, feed-forward, cascade control strategies for heat exchanger, types and operation of dryers, controlled and manipulated variables in dryer control problem, instrumentation for feedback and feed-forward control of various types of dryers.

UNIT - 2

Instrumentation for evaporators & crystallizer

Types and operation of evaporators, Controlled and manipulated variables in evaporator control problem, instrumentation for feedback, feed-forward, cascade control strategies for evaporators, types and operation of crystallizers, controlled and manipulated variables in crystallizer control problem, instrumentation for control of various types of crystallizers.

UNIT - 3

Instrumentation for distillation columns

Operation of distillation column, manipulated and controlled variables in distillation column control, instrumentation for flow control of distillate, top and bottom composition control, reflux ratio control, pressure control schemes.

UNIT - 4

Boiler Instrumentation

Operation of boiler, manipulated and controlled variables in boiler control, safety interlocks and burner management system, instrumentation for boiler pressure controls, air to fuel ratio controls, boiler drum level controls, steam temperature control, optimization of boiler efficiency, operation and types of reactors, instrumentation for temperature, pressure control in CSTRs.

UNIT - 5

Instrumentation for pumps

Types and operation of pumps, manipulated and controlled variables in pump control problem, pump control methods and instrumentation for pump control.

UNIT - 6

Instrumentation for compressors

Types and operation of compressors, capacity control methods of compressors, instrumentation for control of different variables in centrifugal, rotary and reciprocating compressors including surge and anti-surge control.

TEXT/REFERENCE BOOKS

1. "Process Control, Instrument Engineering Hand book", B.G. Liptak, Chilton Book Company.
2. "Hand book of Process Instrumentation", Considine, McGraw Hill Publishing company.

BTEXPE704A

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 Gyrator, 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 Solid State Devices

Microwave bipolar transistor, FET, MESFET, Varactor Diode, PIN Diode, Shottky 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. Samuel Y. Liao, "Microwave Devices and Circuits", 3rd edition, Pearson
2. David M. Pozar, "Microwave Engineering", Fourth edition, Wiley.
3. M. Kulkarni, "Microwave and Radar engineering", 3rd edition, Umesh Publications
4. M L Sisodia & G S Raghuvamshi, "Microwave Circuits and Passive Devices" Wiley, 1987
5. M L Sisodia & G S Raghuvanshi, "Basic Microwave Techniques and Laboratory
6. Manual", New Age International (P) Limited, Publishers.

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 geostationary satellite communication link.
4. Acquired knowledge about Satellite Navigation System.
5. Acquired knowledge about Radar and Radar Equations.

UNIT - 1

Radar Communication

Basic principles and fundamentals, block diagram of basic radar, classification, radar performance factors, radar range equation, factors influencing maximum range, effects of noise, Pulsed radar systems, block diagram and description, antennas and scanning, display methods, moving target indication, radar beacons, other radar systems such as CW Doppler radar, FM CW Doppler radar, phased array radars, planar array radars, various applications of radar such as navigational aids, military, surveillance.

UNIT - 2

Basic Principles satellite communication systems

General features, frequency allocation for satellite services, properties of satellite communication systems, Earth Station: Introduction, earth station subsystem, different types of earth stations

Satellite Orbits

Dr. Babasaheb Ambedkar Technological University, Lonere.

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

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.

BTEXPE704D

Wireless Communication

3 Credits

Course Objectives:

- The objective of the course is to introduce the Concepts of basic wireless mobile communication systems.
- To learn and understand the basic principles of Telecommunication switching, traffic and networks.
- To learn and understand basic concepts of cellular system, wireless propagation and the techniques used to maximize the capacity of cellular network.
- To learn and understand architecture of GSM and CDMA system.
- To understand mobile management, voice signal processing and coding in GSM and CDMA system.

Course Outcomes:

After successfully completing the course students will be able to

1. Explain and apply the concepts telecommunication switching, traffic and networks.
2. Analyze the telecommunication traffic.
3. Analyze radio channel and cellular capacity.
4. Explain and apply concepts of GSM and CDMA system.

UNIT - 1

Introduction and Cellular Concept

Existing technology, Evolution in wireless systems, Trends in cellular system Frequency Reuse channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Cellular System, Design in worst case with an omni Directional Antenna, Co-Channel Interference Reduction with use of Directional Antenna, Improving Coverage and Capacity in Cellular systems, Trunking and Grade of service

UNIT - 2

Wireless Communication Systems GSM

GS Services and features, GSM Architecture and interfaces, GSM Radio Sub System, GSM Channel Types , Traffic Channels, Control Channels, Example of a GSM call, Frame structure for GSM , Signal Processing in GSM, GPRS.

UNIT - 3

Wideband Modulation Techniques and OFDM

Basic Principles, OFDM Signal Mathematical representation, Block Diagram, Selection Parameters for modulation, Pulse shaping, Windowing, Spectral Efficiency, Synchronization

UNIT - 4

Wireless Communication Systems CDMA IS95

Direct sequence Spread Spectrum, Spreading codes, Multipath Signal Propagation and RAKE receiver, Frame Quality and BER Requirements, Critical challenges of CDMA, TIA IS95 System, Physical and Logical Channels of IS95, CDMA IS95 call processing, soft hand off and power control in CDMA, Access and Paging Channel Capacity, Reverse and Forward Link Capacity of a CDMA System.

UNIT - 5

Wireless Communication Systems

CDMA 2000: CDMA layering structure, CDMA 2000 channels, logical channels, forward link physical, forward link features, reverse physical channels, CDMA 2000 Media Access control and LAC sub layer, Data services, Data services in CDMA 2000, mapping of logical channels to physicals, evolution of CDMA IS95 to CDMA 2000.

UNIT - 6

More Wireless Communication Systems

Bluetooth, Wi-Fi Standards, WIMAX, Wireless Sensor Networks, Zigbee, UWB, IEEE 802.20 and Beyond.

TEXT/REFERENCE BOOKS

1. Wireless Communication: Principles and Practice Theodore. S. Rappaport- Pearson Education.
2. Wireless Communication: Upena Dalal, Oxford Higher Education.
3. Wireless Network Evolution: 2G to 3G, Vijay. K. Garg, Pearson Education.

Dr. Babasaheb Ambedkar Technological University, Lonere.

4. Principles and Application of GSM, Vijay Garg, Joseph. E. Wilkes Pearson Education.
5. Mobile Cellular Telecommunications: Analog and Digital Systems, William C. Y. Lee, Tata McGraw Hill Edition.
6. Introduction to Wireless Telecommunication Systems and Networks- Gary. J. Mullet, DELMAR CENGAGE Learning.
7. Wireless Communications and Networks: 3G and Beyond, ITI Saha Misra, Tata McGraw Hill Edition.
8. Fundamentals of Wireless Communication: David Tse, Pramod Viswanath, CAMBRIDGE University Press.
9. Mobile Wireless communications, Mischa Schwartz, CAMBRIDGE University Press.

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