

**B.Tech IV-I Semester(ECE)**

<b>S. No.</b>	<b>Course Code</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	15A04701	Optical Fiber Communication	3	1	-	3
2.	15A04702	Embedded Systems	3	1	-	3
3.	15A04703	Microwave Engineering	3	1	-	3
4.	15A04704	Data Communications and Networking	3	1	-	3
5.	15A04705 15A04706 15A04707	<b>CBCC-II</b> a. Radar Systems b. Adaptive Signal Processing c. FPGA Design	3	1	-	3
6.	15A04708 15A04709 15A04710	<b>CBCC-III</b> a. Digital Image Processing b. Cellular & Mobile Communication c. Real Time Systems	3	1	-	3
7.	15A04711	Microwave and Optical Communication Laboratory	-	-	4	2
8.	15A04712	VLSI & Embedded Systems Laboratory	-	-	4	2
<b>Total:</b>			<b>18</b>	<b>06</b>	<b>08</b>	<b>22</b>

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**15A04701 OPTICAL FIBRE COMMUNICATION**

**Course Objectives:**

- The course gives an account of optical Communication starting with the basic of fiberoptics.
- To give clear understanding of various components such as Optical fibers, Photo detectors, connectors, coupling devices and optical amplifiers Knowledge of various components used in optical networks.
- Knowledge about Various topologies used to construct an optical networks.

**Course Outcomes:**

- Analyze the performance of both digital and analog optical fiber systems
- Calculate the system bandwidth, noise, probability of error and maximum usable bit rate of a digital fiber system
- Calculate the system link loss, distortion and dynamic range of an RF photonic link
- To perform characteristics of fiber sources and detectors, design as well as conduct experiment in software and hardware, and analyze the results to provide valid conclusions.

**UNIT-I**

**Introduction to Optical Fibers:** Evolution of fiber optic system- Element of an Optical Fiber Transmission link- Ray Optics-Optical Fiber Modes and Configurations –Mode theory of Circular Wave guides- Overview of Modes-Key Modal concepts- Linearly Polarized Modes –Single Mode Fibers-Graded Index fiber structure.

**UNIT-II**

**Signal Degradation Optical Fibers:** Attenuation – Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave guides - Information Capacity determination –Group Delay- Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in GI fibers-Mode Coupling –Design Optimization of SM fibers-RI profile and cut-off wavelength.

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### UNIT-III

**Fiber Optical Sources and Coupling** : Direct and indirect Band gap materials-LED structures –Light source materials –Quantum efficiency and LED power, Modulation of a LED, lasers Diodes-Modes and Threshold condition –Rate equations –External Quantum efficiency –Resonant frequencies –Temperature effects, Introduction to Quantum laser, source-to-fiber Power Launching, Lensing schemes, Fiber –to- Fiber joints, Fiber splicing.

### UNIT-IV

**Fiber Optical Receivers** : PIN and APD diodes –Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise –Comparison of Photo detectors – Fundamental Receiver Operation – preamplifiers, Error Sources –Receiver Configuration –Probability of Error – Quantum Limit.

### UNIT-V

**System Design and Applications**: Design of Analog Systems: system specification, power budget, bandwidth budget.

**Design of Digital Systems**: system specification, rise time budget, power budget, Receiver sensitivity.

### Text Books:

1. Gerd Keiser, "Optical Fiber Communication" McGraw –Hill International, Singapore, 3<sup>rd</sup> ed., 2000.
2. J.Senior, "Optical Communication, Principles and Practice", Prentice Hall of India, 1994.

### References:

1. Max Ming-Kang Liu, "Principles and Applications of Optical Communications", TMH, 2010.
2. S.C.Gupta, "Text book on optical fiber communication and its applications", PHI, 2005.
3. Satish Kumar, "Fundamentals of Optical Fiber communications", PHI, 2009.

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**15A04702 EMBEDDED SYSTEMS**

**Course Objectives:**

- To understand the fundamental concepts of Embedded systems.
- To learn the kernel of RTOS, architecture of ARM processor.

**Course Outcomes:**

**After completion the students will be able to**

- Design of embedded systems leading to 32-bit application development.
- Understand hardware-interfacing concepts to connect digital as well as analog sensors while ensuring low power considerations.
- Review and implement the protocols used by microcontroller to communicate with external sensors and actuators in real world.
- Understand Embedded Networking and IoT concepts based upon connected MCUs

**UNIT-I**

**Introduction to Embedded Systems**

Embedded system introduction, host and target concept, embedded applications, features and architecture considerations for embedded systems- ROM, RAM, timers; data and address bus concept, Embedded Processor and their types, Memory types, overview of design process of embedded systems, programming languages and tools for embedded design

**UNIT-II**

**Embedded processor architecture**

CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture. Introduction to ARM architecture and Cortex – M series, Introduction to the TM4C family viz. TM4C123x & TM4C129x and its targeted applications. TM4C block diagram, address space, on-chip peripherals (analog and digital) Register sets, Addressing modes and instruction set basics.

**UNIT- III**

**Overview of Microcontroller and Embedded Systems**

Embedded hardware and various building blocks, Processor Selection for an Embedded System , Interfacing Processor, Memories and I/O Devices, I/O Devices and

I/O interfacing concepts, Timer and Counting Devices, Serial Communication and Advanced I/O, Buses between the Networked Multiple Devices. Embedded System Design and Co-design Issues in System Development Process, Design Cycle in the Development Phase for an Embedded System, Uses of Target System or its Emulator and In-Circuit Emulator (ICE), Use of Software Tools for Development of an Embedded System Design metrics of embedded systems - low power, high performance, engineering cost, time-to-market.

#### **UNIT-IV**

##### **Microcontroller fundamentals for basic programming**

I/O pin multiplexing, pull up/down registers, GPIO control, Memory Mapped Peripherals, programming System registers, Watchdog Timer, need of low power for embedded systems, System Clocks and control, Hibernation Module on TM4C, Active vs Standby current consumption. Introduction to Interrupts, Interrupt vector table, interrupt programming. Basic Timer, Real Time Clock (RTC), Motion Control Peripherals: PWM Module & Quadrature Encoder Interface (QEI).

#### **Unit-V**

##### **Embedded communications protocols and Internet of things**

Synchronous/Asynchronous interfaces (like UART, SPI, I2C, USB), serial communication basics, baud rate concepts, Interfacing digital and analog external device, Implementing and programming UART, SPI and I2C, SPI interface using TM4C. Case Study: Tiva based embedded system application using the interface protocols for communication with external devices “Sensor Hub BoosterPack” Embedded Networking fundamentals, IoT overview and architecture, Overview of wireless sensor networks and design examples. Adding Wi-Fi capability to the Microcontroller, Embedded Wi-Fi, User APIs for Wireless and Networking applications Building IoT applications using CC3100 user API.

Case Study: Tiva based Embedded Networking Application: “Smart Plug with Remote Disconnect and Wi-Fi Connectivity”

#### **Text Books:**

1. Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers, 2014, Create space publications ISBN: 978-1463590154.
2. Embedded Systems: Introduction to ARM Cortex - M Microcontrollers, 5th edition  
Jonathan W Valvano, Createspace publications ISBN-13: 978-1477508992
3. Embedded Systems 2E Raj Kamal, Tata McGraw-Hill Education, 2011 ISBN-0070667640, 9780070667648
4. 0070667640, 9780070667648

**References:**

1. [http://processors.wiki.ti.com/index.php/HandsOn\\_Training\\_for\\_TI\\_Embedded\\_Processors](http://processors.wiki.ti.com/index.php/HandsOn_Training_for_TI_Embedded_Processors)
2. [http://processors.wiki.ti.com/index.php/MCU\\_Day\\_Internet\\_of\\_Things\\_2013\\_Workshop](http://processors.wiki.ti.com/index.php/MCU_Day_Internet_of_Things_2013_Workshop)
3. [http://www.ti.com/ww/en/simplelink\\_embedded\\_wi-fi/home.html](http://www.ti.com/ww/en/simplelink_embedded_wi-fi/home.html)
4. CC3100/CC3200 SimpleLink™ Wi-Fi® Internet-on-a-Chip User Guide Texas Instruments Literature Number: SWRU368A April 2014–Revised August 2015.

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<b>15A04703</b>	<b>MICROWAVE ENGINEERING</b>			

**Course objectives:**

The Objectives of the course are:

- TO develop the knowledge on transmission lines for microwaves, cavity resonators and wave guide components and applications.
- To understand the scattering matrix parameters and its use.
- To introduce the student the microwave test bench for measure different parameters like attenuation, VSWR, etc.,

**Course Outcomes:**

- Ability to analyze micro-wave circuits incorporating hollow, dielectric and planar waveguides, transmission lines, filters and other passive components, active devices.
- Ability to Use S-parameter terminology to describe circuits and to explain how microwave devices and circuits are characterized in terms of their “S”-Parameters.
- Ability to understanding of microwave transmission lines and how to Use microwave components such as isolators, Couplers, Circulators, Tees, Gytrators etc.

**UNIT-I**

**MICROWAVE TRANSMISSION LINES:**Introduction, Microwave spectrum and bands, applications of Microwaves.Rectangular Waveguides-Solution of Wave Equation in Rectangular Coordinates, TE/TM mode analysis, Expressions for fields, Characteristic equation and cutoff frequencies, filter characteristics, dominant and degenerate modes, sketches of TE and TM mode fields in the cross-section.Mode characteristics- Phase and Group velocities, wavelengths and impedance relations, Illustrative Problems.

**Rectangular Waveguides–** Power Transmission and Power Losses, Impossibility of TEM Modes, Micro strip lines-introduction,  $Z_0$  relations, effective dielectric constant, losses, Q-factor, Cavity resonators-introduction, Rectangular and cylindrical cavities, dominant modes and resonant frequencies, Q-factor and coupling coefficients, Illustrative Problems.

## UNIT-II

**WAVEGUIDE COMPONENTS AND APPLICATIONS:** Coupling mechanisms- probe, loop, aperture types. Wave guide discontinuities-waveguide Windows, tuning screws and posts, matched loads. Waveguide attenuators-resistive card, rotary vane Attenuators; waveguide phase shifters-dielectric, rotary vane phase shifters. Wave guide multiport junctions-E plane and H plane Tees, Magic Tee, Directional couplers-2 hole, Bothe hole types, Illustrative Problems. Ferrites-composition and characteristics, Faraday rotation; Ferrite components-Gyrator, Isolator, Circulator.

## UNIT-III

**MICROWAVE TUBES:** Limitations and losses of conventional tubes at microwave frequencies. Microwave tubes-O type and M type classifications. O type tubes: 2 cavity klystrons-structure, Reentrant cavities, velocity modulation process and Applegate diagram, bunching process and small signal theory-Expressions for O/P power and efficiency. Reflex Klystrons-structure, Velocity Modulation, Applegate diagram, mathematical theory of bunching, power output, efficiency, oscillating modes and O/P characteristics, Effect of Repeller Voltage on Power O/P, Illustrative Problems.

**HELIX TWTS:** Significance, types and characteristics of slow wave structures; structure of TWT and amplification process (qualitative treatment), suppression of oscillations, gain considerations.

## UNIT-IV

**M-TYPE TUBES:** Introduction, cross field effects, Magnetrons-different types, cylindrical travelling wave magnetron-Hull cutoff and Hartree conditions, modes of resonance and PI-mode operation, separation of PI-mode, O/P characteristics, Illustrative Problems.

**MICROWAVE SOLID STATE DEVICES:** Introduction, classification, applications, Transfer Electronic Devices, Gunn diode-principles, RWH theory, characteristics, basic modes of operation - Gunn oscillation modes. LSA Mode, Varactor Diode, Parametric Amplifier, Introduction to Avalanche Transit time devices (brief treatment only).

## UNIT-V

### MICROWAVE MEASUREMENTS:

Scattering Matrix-Significance, Formulation and properties. S Matrix calculations for 2-port junction, E plane and H plane Tees, Magic Tee, Directional coupler, circulator and Isolator, Illustrative Problems

Description of Microwave bench-different blocks and their features, errors and precautions; Microwave power measurement-Bolometers, Measurement of attenuation, frequency standing wave measurements –measurement of low and high VSWR, cavity-Q, impedance measurements.



**TEXT BOOKS:**

1. Microwave devices and circuits-Samuel Y. Liao, Pearson, 3<sup>rd</sup> Edition, 2003.
2. Microwave principles-Herbert J.Reich,J.G.Skalnik, P.F.Ordung and H.L.Krauss, CBS publishers and distributors, New Delhi,2004.

**REFERENCES:**

1. Foundations for microwave engineering-R.E.Collin, IEEE press, John Wiley, 2<sup>nd</sup>edition, 2002.
2. Microwave circuits and passive devices-M.L.Sisodia and G.S.Raghuvanshi,Wiley Eastern Ltd.,New age International publishers Ltd., 1995.
3. Microwave engineering passive circuits-Peter A.Rizzi, PHI, 1999.
4. Electronic and Radio Engineering-F.E.Terman, McGraw-Hill, 4<sup>th</sup> Edition, 1995.
5. Microwave Engineering – A. Das, TMH, 2<sup>nd</sup> ed., 2009.

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<b>15A04704</b>	<b>DATA COMMUNICATIONS &amp; NETWORKING</b>			

**UNIT-I**

**Introduction to Networks & Data Communications**

The Internet, Protocols & Standards, Layered Tasks, OSI Model, TCP / IP, Addressing, Line Coding Review, Transmission Media: Guided and unguided Media Review.

**UNIT-II**

**Switching**

Datagram Networks, Virtual Circuit Networks, Structure of a switch ,Ethernet Physical Layer, Data Link Layer: Error detection and Correction Data Link Control: Framing, Flow and Error Control Protocols, Noiseless Channel and Noisy Channel Protocol, HDLC, Point-to-Point Protocol.

**UNIT-III**

**Multiple Access**

RANDOH, CDMA, CSMA/CD, CSMA/CA, Controlled Access, Channelization, Wired LANs: IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, Wireless LAN, IEEE 802.11, Bluetooth IEEE 802.16.

**UNIT-IV**

**Network Layer**

Design Issues, Routing Algorithms, Congestion control, Algorithms.IPV4 Addresses, Connecting Devices, Virtual LAN IPV6 Addresses, Internet Protocol, Hardware Addressing versus IP Addressing, IP Data Gram.

**UNIT-V**

**Transport Layer Protocol**

UDP and TCP, ATM, Cryptography, Network Security

**Text Books:**

1. B. A. Forouzan, "Data Communications and Networking", MGH, 4th ed. 2007.

**Reference Books:**

1. A. S. Tanenbaum, "Computer Networks", PHI.
2. W. Stallings, "Data and Computer Communication", PHI.

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**15A04705 RADAR SYSTEMS  
(CBCC-II)**

**Course Objectives:**

The objectives of course are:

- Radar fundamentals and analysis of radar signals.
- To understand various technologies involved in the design of radar transmitters and receivers.
- To learn various like MTI, Doppler and tracking radar and their comparison.

**Course Outcomes:**

After completion of the course, the student will be able to:

- Understand radar fundamentals and analysis of the radar signals.
- Understand various radar transmitters and receivers.
- Understand various radar like MTI, Doppler and tracking radar and their comparison.

**UNIT I**

**BASICS OF RADAR:** Introduction, Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, Illustrative Problems.

**RADAR EQUATION:** SNR, Envelope Detector, False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems.

**UNIT II**

**CW AND FREQUENCY MODULATED RADAR:** Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, Illustrative Problems.

**FM-CW Radar:** Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar.

**UNIT III**

**MTI AND PULSE DOPPLER RADAR:** Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, And Staggered PRFs. Range

Gated Doppler Filters, MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler radar.

#### **UNIT IV**

**TRACKING RADAR:** Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar – Amplitude Comparison Monopulse (one- and two-coordinates), Phase Comparison Monopulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

#### **UNIT V**

**DETECTION OF RADAR SIGNALS IN NOISE:** Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non-matched Filters, Matched Filter with Non-white Noise.

**RADAR RECEIVERS:** Noise Figure and Noise Temperature, Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Series versus Parallel Feeds, Applications, Advantages and Limitations.

#### **TEXT BOOKS:**

1. Introduction to Radar Systems – Merrill I. Skolnik, TMH Special Indian Edition, 2<sup>nd</sup> Edition, 2007.

#### **REFERENCES:**

1. Introduction to Radar Systems – Merrill I. Skolnik, 3<sup>rd</sup> Edition, Tata McGraw-Hill, 2001.
2. Radar Principals, Technology, Applications – Byron Edde, Pearson Education, 2004.
3. Radar Principles – Peebles, Jr., P.Z.Wiley, NweYork, 1998.

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**15A04706 ADAPTIVE SIGNAL PROCESSING  
(CBCC-II)**

**Course Objective:**

- To study in detail about adaptive Systems.
- To study about various Linear optimum filtering techniques.
- To study about various techniques related Linear and Non Linear adaptive filtering.

**Course outcome:**

- After the course students is expected to be able to:
- Get complete knowledge regarding adaptive systems
- Design various linear optimum filters by employing different techniques associated withthem
- Understand various techniques related to with linear and nonlinear adaptive filtering and their design considerations

**UNIT I:**

**Introduction to Adaptive Systems:** Eigen Analysis - Eigen Value problem, Properties of eigen values and eigen vectors, Eigen filters, Eigen value computations, Adaptive Systems - Definitions, Characteristics, Applications and Examples of Adaptive systems, The adaptive linear combiner – Description, weight vectors, Desired response performance function, Gradient and Mean square error(MSE).

**UNIT II:**

**Linear Optimum Filtering:** Wiener Filters – Linear optimum filtering, Principle of Orthogonality, Wiener-Hopf equations, Error performance surface, Channel Equalization, Linearly constrained minimum variance filter, Linear Prediction – Forward and Backward linear prediction, Levinson-Durbin Algorithm, Properties of prediction error filters, AR modeling of stationary stochastic process, Lattice predictors, Joint process estimation, Kalman Filters - Recursive mean square estimation for scalar random variables, Kalman filtering problem, The innovations process, Estimation of the state using innovations process, Filtering, Initial conditions, Variants of the Kalman filter, Extended Kalman filter, Problem Solving.

**UNIT III:**

**Linear Adaptive Filtering-I:** Method of Steepest descent algorithm and its stability, Least Means Square (LMS) algorithm – Structure & operation of LMS algorithm, Examples, Stability & performance analysis of the LMS algorithm, Simulations of Adaptive equalization using LMS algorithm, Convergence aspects, Method of Least Squares (LS) - Statement, Data windowing, Minimum sum of error squares, Normal equations and linear least squares filters, Properties.

**UNIT IV:**

**Linear Adaptive Filtering-II** Recursive Least Squares (RLS) Algorithm – Matrix inversion lemma, The exponentially weighted RLS algorithm, Update recursion for the sum of weighted error squares, Example, Convergence Analysis, Simulation of adaptive equalization using RLS algorithm, Order Recursive Adaptive Filters – Adaptive forward and backward linear prediction, Least squares Lattice predictor, QR-Decomposition based Least squares Lattice filters & their properties, Simulation of Adaptive equalization using Lattice Filter.

**UNIT V:**

**Nonlinear Adaptive Filtering:** Blind deconvolution – Theoretical and practical considerations, Bussgang algorithm for blind equalization for real base band channels, Special cases of Bussgang algorithm, Simulation studies of Bussgang algorithms, SVD, Problem solving.

**Text Books:**

1. Simon Haykin, "Adaptive Filter Theory," Prentice Hall, 4th Edition, 2002.
2. Bernard Widrow, Samuel D. Stearns, "Adaptive Signal Processing," Prentice Hall, 2005.

**References:**

1. Paulo S.R. Diniz, Adaptive Filtering Algorithms and Practical Implementation, Third Edition, Springer, Kluwer Academic Publishers.
2. Alexander D Poularikas, Zayed M Ramadan, Adaptive Filtering Primer with MATLAB, CRC Press Taylor & Francis Group, 2008 Indian Edition.
3. Ali H. Sayed, Adaptive filters, IEEE Press, Wiley-Interscience, A John Wiley & Sons, INC., Publication.
4. S. Thomas Alexander, "Adaptive Signal Processing-Theory & Applications," Springer –Verlag, 1986

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**15A04707 FPGA DESIGN  
(CBCS-II)**

**UNIT-I**

**Introduction to Field-programmable Gate Arrays**

Programmability and DSP. A Short History of the Microchip, Challenges of FPGAs, DSP System Basics, DSP System Definitions, DSP Transforms, Filter Structures, Adaptive Filtering , Basics of Adaptive Filtering

**UNIT-II**

**Arithmetic Basics**

Number Systems, Fixed-point and Floating-point, Arithmetic Operations, Fixed-point versus Floating-point, Technology Review: Introduction, Architecture and Programmability, DSP Functionality Characteristics .Processor Classification, Microprocessors, DSP processors.

**UNIT-III**

**Current FPGA Technologies**

Introduction, Toward FPGA, Altera FPGATEchnologies, Xilinx FPGA Technologies, Detailed FPGA Implementation Issues: Introduction, Various Forms of the LUT, Memory Availability, Fixed Coefficient Design Techniques, Distributed Arithmetic, Reduced Coefficient Multiplier, Rapid DSP System Design Tools and Processes for FPGA: Introduction, Design Methodology Requirements for FPGA DSP, IP Core Generation Tools for FPGA, System level Design Tools for FPGA.

**UNIT-IV**

**The IRIS Behavioral Synthesis**

Introduction of Behavioral Synthesis Tools, Hierarchical Design Methodology, Hardware Sharing Implementation (Scheduling Algorithm) for IRIS.DECISION ANALYSIS AND SUPPORT: Decision Making., Modeling throughout System Development, Modeling for Decision.

**UNIT-V**

**Complex DSP Core Design for FPGA**

Motivation for Design for Reuse, Intellectual Property (IP) Cores, Evolution of IP Cores. Model-based Design for Heterogeneous FPGA: Dataflow Modeling and Rapid Implementation for FPGA DSP Systems, Rapid Synthesis and Optimization of Embedded Software from DFGs, System-level Modeling for Heterogeneous Embedded

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DSP Systems, System level Design and Exploration of Dedicated Hardware Network, Adaptive Beam former Example, Low Power FPGA Implementation.

**TEXT BOOKS:**

1. Roger Woods, John McAllister, Gaye Light body, Ying Yi, FPGA-based Implementation of Signal Processing Systems, Wiley, 2008.
2. John V. Old Field, Richrad C. Dorf, Field Programmable Gate Arrays, Wiley, 2008.
3. Michel John Sebastian Smith, Application Specific Integrated Circuits, Addison Wesley Professional, 2008.
4. Stephen D. Brown, Robert J. Francis, Jonathan Rose, Zvonko G. Vranesic, Field Programmable Gate Arrays, 2nd Edition, Springer, 1992.



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**15A04708 DIGITAL IMAGE PROCESSING  
(CBCC-III)**

**OBJECTIVES:**

- To know the fundamentals of Image Processing
- To know about various techniques of image enhancement, reconstruction and image compression.

**Course Outcomes:**

- Able to apply the Image processing concept for various fields of engineering and real life process as per needs & specifications.
- Get the skills to Heuristically develop new techniques to process images of any context
- Can experiment, analyze & interpret imagedata /processing data.

**UNIT-I**

Introduction to Digital Image processing – Example fields of its usage- Image sensing and Acquisition – image Modeling - Sampling, Quantization and Digital Image representation - Basic relationships between pixels, - Mathematical tools/ operations applied on images - imaging geometry.

**UNIT-II**

2D Orthogonal and Unitary Transforms and their properties - Fast Algorithms - Discrete Fourier Transform - Discrete Cosine Transforms- Walsh- Hadamard Transforms- Hotelling Transforms , Comparison of properties of the above.

**UNIT-III**

Background enhancement by point processing Histogram processing, Spatial filtering, Enhancement in frequency Domain, Image smoothing, Image sharpening, Colour image Enhancement

**UNIT-IV**

Degradation model, Algebraic approach to restoration – Inverse filtering – Least Mean Square filters, Constrained Least square restoration, Blind Deconvolution.  
Image segmentation: Edge detection -, Edge linking , Threshold based segmentation methods – Region based Approaches - Template matching –use of motion in segmentation

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**UNIT-V**

Redundancies in Images - Compression models, Information theoretic perspective- Fundamental coding theorem. Huffman Coding, Arithmetic coding, Bit plane coding, Run length coding, Transform coding, Image Formats and compression standards.

**Text Books:**

1. R.C .Gonzalez & R.E. Woods, "Digital Image Processing", Addison Wesley/Pearson education, 3rd Edition, 2010.
2. A .K. Jain, "Fundamentals of Digital Image processing", PHI.

**References:**

1. Rafael C. Gonzalez, Richard E woods and Steven L.Eddins, "Digital Image processing using MATLAB", Tata McGraw Hill, 2010.
2. S jayaraman, S Esakkirajan, T Veerakumar, "Digital Image processing",Tata McGraw Hill
3. William K. Pratt, "Digital Image Processing", John Wiley, 3rd Edition, 2004.

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**15A04709 CELLULAR & MOBILE COMMUNICATION  
(CBCC-III)**

**OBJECTIVES:**

- To enable the student to synthesis and analyze wireless and mobile cellular communication systems over a stochastic fading channel.
- To provide the student with an understanding of advanced multiple access techniques.
- To provide the student with an understanding of diversity reception techniques. • To give the student an understanding of digital cellular systems (GSM, CDMA One, GPRS, CDMA 2000, and W-CDMA).

**Course Outcomes:**

By the end of this course, the student will be able to analyze and design wireless and mobile cellular systems.

- The student will be able to understand impairments due to multipath fading channel.
- Understand the fundamental techniques to overcome the different fading effects.
- To understand Co-channel and Non Co-channel interferences.
- Able to familiar with cell coverage for signal and traffic, diversity techniques and mobile antennas.
- Understanding of frequency management, channel assignment and types of handoff.

**UNIT I**

**CELLULAR MOBILE RADIO SYSTEMS:**Introduction to Cellular Mobile system, performance criteria, uniqueness of mobile radio environment, operation of cellular systems, Hexagonal shaped cells, Analog and Digital Cellular systems.

**ELEMENTS OF CELLULAR RADIO SYSTEM DESIGN:**General description of the problem, concept of frequency channels, Co-channel Interference Reduction Factor, desired C/I from a normal case in a Omni directional Antenna system, Cell splitting, consideration of the components of cellular system.

**UNIT II**

**INTERFERENCE:** Introduction to Co-channel interference, real time co-channel interference, Co-channel measurement, design of Antenna system, Antenna parameters and their effects, diversity receiver, non-co-channel interference-different types.

### **UNIT III**

**CELL COVERAGE FOR SIGNAL AND TRAFFIC:**Signal reflections in flat and hilly terrain, effect of human made structures, phase difference between direct and reflected paths, constant standard deviation, straight line path loss slope, general formula for mobile propagation over water and flat open area, near and long distance propagation antenna height gain, form of a point to point model.

### **UNIT IV**

**CELL SITE AND MOBILE ANTENNAS:**Sum and difference patterns and their synthesis, Omni directional antennas, directional antennas for interference reduction, space diversity antennas, umbrella pattern antennas, minimum separation of cell site antennas, high gain antennas.

**FREQUENCY MANAGEMENT AND CHANNEL ASSIGNMENT:**Numbering and grouping, setup access and paging channels channel assignments to cell sites and mobile units, channel sharing and borrowing, sectorization, overlaid cells, non-fixed channel assignment.

### **UNIT V**

**HANDOFF:**Handoff, dropped calls and cell splitting, types of handoff, handoff invitation, delaying handoff, forced handoff, mobile assigned handoff. Intersystem handoff, cell splitting, micro cells, vehicle locating methods, dropped call rates and their evaluation.

**DIGITAL CELLULAR NETWORKS:** GSM architecture, GSM channels, multiplex access scheme, TDMA, CDMA.

#### **TEXT BOOKS:**

1. Mobile cellular telecommunications-W .C. Y. Lee, Tata Mc-Graw Hill, 2<sup>nd</sup> Edition, 2006.
2. Wireless communications-Theodore. S. Rapport, Pearson Education, 2<sup>nd</sup> Edn., 2002.

#### **REFERENCES:**

1. Principles of Mobile communications-Gordon L. Stuber, Springer International 2<sup>nd</sup> Edition, 2007.
2. Wireless and Mobile Communications-Lee McGraw Hills, 3<sup>rd</sup> Edition, 2006.
3. Wireless communications and Networking-Jon W.Mark and WeihuaZhqung, PHI, 2005.
4. Wireless communication Technology-R.Blake, Thompson Asia Pvt.Ltd., 2004.

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**B. Tech IV-ISem. (ECE)**

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<b>3</b>	<b>1</b>	<b>0</b>	<b>3</b>

**15A04710 REAL TIME SYSTEMS  
(CBCC-III)**

**Course Outcomes**

**After completion of the course students able to**

- Know about the basic concepts of embedded systems
- Understand the different architectural features of embedded systems
- Understand the goal embedded systems in real time design applications

**UNIT-I**

**Introduction to Real Time System**

Introduction to Real time Embedded System, need for a real-time system, different kinds (reactive, time driven, deadline driven, etc..) Embedded system Design cycle, Types of Real Time systems, Real Time Applications and features, Issues in real time computing, aspects of real-time systems (timeliness, responsiveness, concurrency, predictability, correctness, robustness, fault tolerance and safety, resource limitations, RTOS necessity), real-time requirement specifications, modelling/verifying design tools (UML, state charts, etc..).

**UNIT-II**

**Embedded Hardware for Real Time System**

Selection criteria for Real time system - Hardware and Software perspective, need for partitioning, criteria for partitioning (performance, criticality, development ease, robustness, fault tolerance and safety, resource limitations, etc..), System Considerations, Basic development environment-host vs target concept, CPU features, Architecture, I/O Ports, on-chip peripherals, Memory, Real time implementation considerations, bus architecture, Introduction to Interrupts, Interrupt vector table, interrupt programming, Pipeline and Parallelism concepts.

Case study of C2000 architecture, Real time applications by interfacing C2000 with sensors and actuators (example: Motor Control, Digital Power, and Power Line Communication)

**UNIT III**

**Embedded Hardware – On chip Peripherals and Communication protocols –**

Role of peripherals for Real time systems, On-Chip peripherals & hardware accelerators, Peripherals [Direct Memory Access, Timers, Analog to Digital Conversion (ADC), DAC, Comparator, Pulse Width Modulation (PWM)],Need of real time

Communication, Communication Requirements, Timeliness, Dependability, Design Issues, Overview of Real time communication, Real time Communication Peripherals – I2C, SPI & UART

Case study - Illustration of configuring and interfacing the peripherals (timers, ADC, DAC, and PWM) and Real time communication protocols (I2C, SPI & UART) using C2000 platforms

## **UNIT IV**

### **Embedded Software and RTOS**

Software Architecture of real time System, Introduction to RTOS, role of RTOS, foreground Back ground system, pros and cons, Real time kernel, qualities of good RTOS, Functionalities of RTOS – Task Management, I/O management, Memory management, Inter Task Communication, Tasks, Task states, Task control block, attributes of TCB, Context switching, Interrupts handling, Multiprocessing and multitasking

Case study examples for demonstrating task management functionalities (ex: Task switching, task deleting, task suspending and resuming, managing priority and etc.,) using TI RTOS on C2000 platforms.

## **UNIT-V**

### **Scheduling, Synchronization and Inter task communication in Real Time Systems**

Basic Concepts for Real-Time Task Scheduling, Scheduling criteria, Overview of Scheduling policies, Task Synchronization – Need of synchronization, shared data problems and its ways of handling, Role of Semaphore, types of semaphores, semaphore functions, Inter task communication – Need of communication, Message Mailbox and Message Queues, RTOS problems - Priority inversion phenomenon, Deadlock phenomenon and steps to handle them.

Case study examples to demonstrate concepts of task synchronization (Semaphore) and Inter task communication (Mailbox and Message queues), using TI RTOS for C2000 platforms

## **TEXT BOOKS**

1. Real-Time Systems by Jane W. S. Liu Prentice Hall; 1 edition ISBN: 978-0130996510
2. Krishna .C.M “Real Time Systems” Mc-Graw Hill Publication.
3. Hamid A. Toliyat and Steven G. Campbell, “DSP based Electromechanical Motion Control” CRC Press, 2003, ISBN 9780849319181.
4. Jean J Labrosse, “Embedded System Design blocks”, CMP books, Second Edition, ISBN 0-87930-604-1

5. John H Davies, "MSP430 Microcontroller Basics" Newnes, 2<sup>nd</sup> edition, ISBN-13: 978-0750682763

## **REFERENCES**

1. TMS320C28x CPU and Instruction Set Reference Guide, TI Literature Number: SPRU 430E, Revised January 2009
2. TMS320x28xx, 28xxx DSP Peripheral Reference Guide, TI Literature Number: SPRU566J, Revised April 2011
3. C2000 Teaching CD ROM from Texas Instruments
4. Intro to the TI-RTOS Kernel Workshop Lab Manual, by Texas Instruments, Rev 2.3 – December 2014
5. [http://processors.wiki.ti.com/index.php/C2000\\_32-bit\\_Real-Time\\_MCU\\_Training](http://processors.wiki.ti.com/index.php/C2000_32-bit_Real-Time_MCU_Training)

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<b>B. Tech IV-ISem. (ECE)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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**15A04711 MICROWAVE & OPTICAL COMMUNICATIONS LABORATORY****Course Outcomes:**

- Capable of Applying microwave Concepts/ Microwave components and test them .
- Able to design and analyse an optical fiber communications link

**Microwave Lab (PART – A) --- Any Seven (7) Experiments**

1. Reflex Klystron Characteristics.
2. Gunn Diode Characteristics.
3. Attenuation Measurement.
4. Directional Coupler Characteristics.
5. VSWR Measurement.
6. Impedance Measurement.
7. Frequency and Wavelength measurements using slotted section.
8. Impedance Matching and Tuning
9. Scattering parameters of Magic Tee.
10. Radiation Pattern Measurement of horn Antennas (at least two antennas).

**Optical Fiber Lab (PART – B) --- Any five (5) Experiments**

1. Characterization of LED.
2. Characterization of Laser Diode.
3. Intensity modulation of Laser output through an optical fiber.
4. Measurement of Data rate for Digital Optical link.
5. Measurement of Numerical Aperture of the given fiber.
6. Measurement of losses for Analog Optical link.

**Equipment required for Laboratories:**

1. Regulated Klystron Power Supply 6 nos.
2. VSWR Meter 6 nos.
3. Milli/Micro Ammeters 10 nos.
4. Multi meters 10 nos.
5. CROs 8 nos.
6. GUNN Power Supply, Pin Moderator 4 nos.
7. Relevant Microwave components --
8. Fiber Optic Analog Trainer based LED 3 nos.
9. Fiber Optic Analog Trainer based laser 2 nos.
10. Fiber Optic Digital Trainer 1 no.
11. Fiber cables - (Plastic, Glass)



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	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**15A04712 VLSI & EMBEDDED SYSTEMS LABORATORY**

**Note:** The students are required to perform any **Six** Experiments from each Part of the following.

**Part-A: VLSI Lab**

**Course Objective:**

- To design and draw the internal structure of the various digital integrated circuits
- To develop VHDL/Verilog HDL source code, perform simulation using relevant simulator and analyze the obtained simulation results using necessary synthesizer.
- To verify the logical operations of the digital ICs (Hardware) in the laboratory.

**Course Outcome:**

After completion of the course the students will be able to

- Design and draw the internal structure of the various digital integrated circuits
- Develop VHDL/Verilog HDL source code, perform simulation using relevant simulator and analyze the obtained simulation results using necessary synthesizer.
- Verify the logical operations of the digital IC's (Hardware) in the laboratory

**Note: For the following list of experiments students are required to do the following.**

- Target Device Specifications
- Simulation
- Synthesize the design
- Generate RTL Schematic.
- Generate Technology Map.
- Generate Synthesis report.
- Design Summary.

**List of Experiments:**

**Note: Use VHDL/ Verilog HDL**

1. Realization of Logic Gates.
2. 3- to - 8Decoder- 74138.
3. 8 x 1 Multiplexer-74151 and 2 x 4 De-multiplexer-74155.
4. 4-Bit Comparator-7485.

5. D Flip-Flop-7474.
6. Decade counter-7490.
7. Shift registers-7495.
8. ALU Design.

**Part B : Embedded C Experiments using TM4C processor:**

1. Learn and understand how to configure EK-TM4C123GXL Launchpad digital I/O pins. Write a C program for configuration of GPIO ports for Input and output operation (blinking LEDs, push buttons interface).

**Exercises:**

- a) Modify the code to make the red LED of EK-TM4C123GXL Launchpad blink.
  - b) Modify the code to make the green and red LEDs blink:
    - I. Together
    - II. Alternately
  - c) Alter the code to turn the LED ON when the button is pressed and OFF when it is released.
  - d) Modify the delay with which the LED blinks.
  - e) Alter the code to make the green LED stay ON for around 1 second every time the button is pressed.
  - f) Alter the code to turn the red LED ON when the button is pressed and the green LED ON when the button is released.
2. Learn and understand Timer based interrupt programming. Write a C program for EK-TM4C123GXL Launchpad and associated Timer ISR to toggle onboard LED using interrupt programming technique.

**Exercises:**

- a) Modify the code for a different timer toggling frequency.
  - b) Write the code to turn on interrupt globally.
3. Configure hibernation module of the TM4C123GH6PM microcontroller to place the device in low power state and then to wake up the device on RTC (Real- Time Clock) interrupt.

**Exercises:**

- a) Write a program to configure hibernation mode and wake up the EK-TM4C123GXL Launchpad when onboard switch SW2 is pressed.
4. Configure in-build ADC of TM4C123GH6PM microcontroller and interface potentiometer with EK-TM4C123GXL Launchpad to observe corresponding 12- bit digital value.

**Exercises:**

- a) Tabulate ten different position of the Potentiometer and note down the Digital value and calculate the equivalent analog value.

- b) Use the ADC to obtain the analog value from the internal temperature sensor.
  - c) Configure Dual ADC modules to read from 2 analog input (could be from 2 potentiometers)
  - d) What are the trigger control mechanism for this ADC?
  - e) What does the resolution refer on ADC Specification?
  - f) The current sampling method is single ended sampling. This ADC could also be configured to do differential sampling.  
What is the difference between the two methods of sampling?
5. Learn and understand the generation of Pulse Width Module (PWM) signal by configuring and programming the in-built PWM module of TM4C123GH6PM microcontroller.

**Exercises:**

- a) Change the software to output a set Duty Cycle, which can be user programmed.
  - b) Change the frequency of the PWM Output from 6.25 KHz to 10 KHz and do the tabulation again.
  - c) Generate Complementary signals, route it to two pins, and observe the waveforms.
  - d) What is dead band generation mean and where is it applied?
  - e) Is it possible to construct a DAC from a PWM? Identify the additional components and connection diagram for the same.
  - f) Sketch the gate control sequence of 3 phase Inverter Bridge and how many PWM generator blocks are required? Can we generate this from TIVA Launchpad?
6. Configure the PWM and ADC modules of TM4C123GH6PM microcontroller to control the speed of a DC motor with a PWM signal based on the potentiometer output.

**Exercises:**

- a) With the same ADC input configure 2 PWM generator modules with 2 different frequencies.
  - b) Read the Internal temperature sensor and control a DC Motor that could be deployed in fan Controller by observing the unit or ambient temperature.
  - c) What is the resolution of the PWM in this experiment?
  - d) What would be the maximum frequency that can be generated from the PWM generator?
  - e) Briefly explain an integrated application of ADC and PWM based control.
7. Learn and understand to connect EK-TM4C123GXL Launchpad to PC terminal and send an echo of the data input back to the PC using UART.

**Exercises:**

- a) Change the baud rate to 19200 and repeat the experiment.
  - b) What is the maximum baud rate that can be set in the UART peripheral of TIVA?
  - c) Modify the software to display “Switch pressed” by pressing a user input switch on the Launchpad.
8. Learn and understand interfacing of accelerometer in Sensor Hub Booster pack with EK-TM4C123GXL Launchpad using I2C.

**Exercises:**

- a) Make a LED ON when the acceleration value in the x axis crosses a certain limit, say +5.
  - b) What is the precaution taken in this experiment in order to avoid the overflow of UART buffer?
  - c) Change the value of PRINT\_SKIP\_COUNT to 100 and see the difference in the output.
  - d) Change MPU9150\_ACCEL\_CONFIG\_AFS\_SEL\_2G to MPU9150\_ACCEL\_CONFIG\_AFS\_SEL\_4G on line 461 of the same source file and Observe the difference.
9. USB bulk transfer mode:  
Learn and understand to transfer data using bulk transfer mode with the USB2.0 peripheral of the TM4C123GH6PM device.

**Exercises:**

- a) What are the different modes offered by USB 2.0?
  - b) What are the typical devices that use Bulk transfer mode?
10. Learn and understand to find the angle and hypotenuse of a right angle triangle using IQmath library of TivaWare.

**Exercises:**

- a) Change the base and adjacent values in the program to other values, build the program and observe the values in the watch window.
  - b) Open IQmathLib.h and browse through the available functions. What function is to be used if the IQ number used in the program is to be converted to a string?
11. Learn and understand interfacing of CC3100 WiFi module with EK-TM4C123GXL Launchpad and configuration of static IP address for CC3100 booster pack.

**Exercises:**

- a) Try pinging the same IP address before connecting to the Access Point (AP) and note down the observation.
  - b) What is the difference between static IP address and dynamic IP address?
12. Configure CC3100 Booster Pack connected to EK-TM4C123GXL Launchpad as a Wireless Local Area Network (WLAN) Station to send Email over SMTP.

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**Exercises:**

- a) In the terminal output window, we have received a debug message “Pinging...!”. Search in the code and change the message to “Pinging the website”. Repeat the experiment to observe this change in the Serial Window.
  - b) In line no:62 of main. C replace [www.ti.com](http://www.ti.com) with any non-existing web address and repeat the experiment and observe what happens
  - c) In line no: 62 of main. C replace again with [www.ti.com](http://www.ti.com) and repeat the experiment.
  - d) Identify the code that helps in establishing connection over SMTP. Modify the code to trigger E-mail application based upon external analog input.
  - e) How to configure the AP WLAN parameters and network parameters (IP addresses and DHCP parameters) using CC3100 API.
13. Configure CC3100 Booster Pack connected to EK-TM4C123GXL Launchpad as a HTTP server.

**Exercises:**

- a) Where are the webpages stored in the CC3100?
- b) What happens if we try to access a webpage, which is not there inside the CC3100?
- c) List 3 applications with a 3 to 4-line brief description that you think can be performed with this experimental setup.