



**MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT  
(AUTONOMOUS)**

**M.TECH in EMBEDDED SYSTEMS  
COURSE STRUCTURE & SYLLABUS (R19)**

**Applicable For 2019-20 Admitted Batch**

**I M.Tech - I Sem**

S. No.	Course Code	Course Name	Course Area	Periods per week			Credits	Scheme of Examination Maximum Marks		
				L	T	P		Internal (CIE)	External (SEE)	Total
1	1915502	Microcontrollers & Programmable Digital Signal Processors	PC	3	0	0	3	30	70	100
2	1915503	System Design with Embedded Linux	PC	3	0	0	3	30	70	100
3	191550X	Professional Elective - I	PE	3	0	0	3	30	70	100
4	19155XX	Professional Elective - II	PE	3	0	0	3	30	70	100
5	1915521	Microcontrollers & Programmable Digital Signal Processors Lab	PC	0	0	3	2	30	70	100
6	1915522	System Design with Embedded Linux Lab	PC	0	0	3	2	30	70	100
7	1915501	Research Methodology & IPR	MC-I	2	0	0	2	30	70	100
8	19155XX	Audit Course - I	AC-I	2	0	0	0	-	-	-
<b>TOTAL</b>				<b>16</b>	<b>0</b>	<b>6</b>	<b>18</b>	<b>210</b>	<b>490</b>	<b>700</b>

**I M.Tech - II Sem**

S. No.	Course Code	Course Name	Course Area	Periods per week			Credits	Scheme of Examination Maximum Marks		
				L	T	P		Internal (CIE)	External (SEE)	Total
1	1925504	RTL Simulation and Synthesis with PLDs	PC	3	0	0	3	30	70	100
2	1925505	Advanced Digital Signal Processing	PC	3	0	0	3	30	70	100
3	19255XX	Professional Elective - III	PE	3	0	0	3	30	70	100
4	19255XX	Professional Elective - IV	PE	3	0	0	3	30	70	100
5	1925523	RTL Simulation and Synthesis with PLDs Lab	PC	0	0	3	2	30	70	100
6	1925524	Advanced Digital Signal Processing Lab	PC	0	0	3	2	30	70	100
7	1925525	Mini Project with Seminar	PS	0	0	4	2	30	70	100
8	19255XX	Audit Course- II	AC-II	2	0	0	0	-	-	-
<b>TOTAL</b>				<b>14</b>	<b>0</b>	<b>10</b>	<b>18</b>	<b>210</b>	<b>490</b>	<b>700</b>



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**II M.Tech - I Sem**

S. No.	Course Code	Course Name	Course Area	Periods per week			Credits	Scheme of Examination Maximum Marks		
				L	T	P		Internal (CIE)	External (SEE)	Total
1	19355XX	Professional Elective - V	PE	3	0	0	3	30	70	100
2	19355XX	Open Elective	OE	3	0	0	3	30	70	100
3	1935526	Dissertation Work Review - II	PS	0	0	12	6	100	0	100
<b>TOTAL</b>				<b>6</b>	<b>0</b>	<b>12</b>	<b>12</b>	<b>160</b>	<b>140</b>	<b>300</b>

**II M.Tech - II Sem**

S. No.	Course Code	Course Name	Course Area	Periods per week			Credits	Scheme of Examination Maximum Marks		
				L	T	P		Internal (CIE)	External (SEE)	Total
1	1945527	Dissertation Work Review - III	PS	0	0	12	6	100	0	100
2	1945528	Dissertation Viva-Voce	PS	0	0	28	14	0	100	100
<b>TOTAL</b>				<b>0</b>	<b>0</b>	<b>40</b>	<b>20</b>	<b>100</b>	<b>100</b>	<b>200</b>



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**Audit Course – I & II**

<b>S. No.</b>	<b>Course Code</b>	<b>Audit Course Title</b>
1	1915528	English for Research Paper Writing
2	1915529	Disaster Management
3	1915530	Sanskrit for Technical Knowledge
4	1915531	Value Education
5	1925532	Constitution of India
6	1925533	Pedagogy Studies
7	1925534	Stress Management by yoga
8	1925535	Personality Development Through Life Enlightenment Skills



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**Professional Elective (PE) Courses**

**Professional Elective-I**

S. No.	Course Code	Course Title
1	1915506	Programming Languages for Embedded Software
2	1915507	AI & Machine Learning
3	1915508	Computer Vision

**Professional Elective-II**

S. No.	Course Code	Course Title
1	1915509	Communication Buses & Interfaces
2	1915510	Parallel Processing
3	1915511	Advanced Computer architecture

**Professional Elective-III**

S. No.	Course Code	Course Title
1	1925512	IOT & Applications
2	1925513	VLSI Signal Processing
3	1925514	SOC Architecture

**Professional Elective-IV**

S. No.	Course Code	Course Title
1	1925515	Hardware Software Co-Design
2	1925516	Network Security and Cryptography
3	1925517	Physical Design Automation

**Professional Elective-V**

S. No.	Course Code	Course Title
1	1935519	Scripting Languages
2	1935520	Memory Technologies
3	1935521	Wireless Sensor Networks

**Open Elective (OE) Course for Other Branches**

S. No.	Course Code	Course Title
1	1935501	Fundamentals of Nano Technology

**MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT  
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**M.TECH.- I YEAR- I SEMESTER  
EMBEDDED SYSTEMS**

**MICROCONTROLLERS AND PROGRAMMABLE DIGITAL SIGNAL PROCESSORS (PC – I)**

**Course Outcomes:** At the end of this course, students will be able to

1. Compare and select ARM processor core based SoC with several features/peripherals based on requirements of embedded applications.
2. Identify and characterize architecture of Programmable DSP Processors
3. Develop small applications by utilizing the ARM processor core and DSP processor based platform.

**UNIT-I**

ARM Cortex-M3 processor: Applications, Programming model – Registers, Operation - modes, Exceptions and Interrupts, Reset Sequence Instruction Set, Unified Assembler Language, Memory Maps, Memory Access Attributes, Permissions, Bit-Band Operations, Unaligned and Exclusive Transfers. Pipeline, Bus Interfaces.

**UNIT-II**

Exceptions, Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor and Pendable Service Call, Nested Vectored Interrupt Controller, Basic Configuration, SYSTICK Timer, Interrupt Sequences, Exits, Tail Chaining, Interrupt Latency.

**UNIT-III**

LPC 17xx microcontroller- Internal memory, GPIOs, Timers, ADC, UART and other serial interfaces, PWM, RTC, WDT.

**UNIT-IV**

Programmable DSP (P-DSP) Processors: Harvard architecture, Multi port memory, architectural structure of P-DSP- MAC unit, Barrel shifters, Introduction to TI DSP processor family

**UNIT-V**

VLIW architecture and TMS320C6000 series, architecture study, data paths, cross paths, Introduction to Instruction level architecture of C6000 family, Assembly Instructions memory addressing, for arithmetic, logical operations

**TEXTBOOKS:**

1. Joseph Yiu, "The definitive guide to ARM Cortex-M3", Elsevier, 2<sup>nd</sup> Edition
2. Venkatramani B. and Bhaskar M. "Digital Signal Processors: Architecture, Programming and Applications" , TMH , 2<sup>nd</sup> Edition

**REFERENCES:**

1. Sloss Andrew N, Symes Dominic, Wright Chris, "ARM System Developer's Guide: Designing and Optimizing", Morgan Kaufman Publication.
2. Steve furber, "ARM System-on-Chip Architecture", Pearson Education
3. Frank Vahid and Tony Givargis, "Embedded System Design", Wiley
4. Technical references and user manuals on [www.arm.com](http://www.arm.com), NXP Semiconductor [www.nxp.com](http://www.nxp.com) and Texas Instruments [www.ti.com](http://www.ti.com)

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**M.TECH.- I YEAR- I SEMESTER  
EMBEDDED SYSTEMS**

**SYSTEM DESIGN WITH EMBEDDED LINUX (PC – II)**

**Course Outcomes:** At the end of this course, students will be able to

1. Familiarity of the embedded Linux development model.
2. Write, debug, and profile applications and drivers in embedded Linux.
3. Understand and create Linux BSP for a hardware platform

**UNIT-I**

Introduction to Real Time Operating Systems: Characteristics of RTOS, Tasks Specifications and types, Real-Time Scheduling Algorithms, Concurrency, Inter-process Communication and Synchronization mechanisms, Priority Inversion, Inheritance and Ceiling.  
Embedded Linux Vs Desktop Linux, Embedded Linux Distributions, System calls, Static and dynamic libraries, Cross tool chains

**UNIT-II**

Embedded Linux Architecture, Kernel Architecture – HAL, Memory manager, Scheduler, File System, I/O and Networking subsystem, IPC, User space, Start-up sequence

**UNIT-III**

Board Support Package Embedded Storage: MTD, Architecture, Drivers, Embedded File System  
Embedded Device Drivers: Communication between user space and kernel space drivers, Character and Block Device Drivers, Interrupt handling, Kernel modules  
Embedded Drivers: Serial, Ethernet, I2 C, USB, Timer, Kernel Modules

**UNIT-IV**

Porting Applications Real-Time Linux: Linux and Real time, Programming, Hard Real-time Linux

**UNIT-V**

Building and Debugging: Bootloaders, Kernel, Root file system, Device Tree

**TEXT BOOKS:**

1. Chris Simmonds “Mastering Embedded Linux Programming” - Second Edition, PACKT Publications Limited.
2. Karim Yaghmour, “Building Imbedded Linux Systems”, O'Reilly & Associates
3. P Raghvan, Amol Lad, Sriram Neelakandan, “Embedded Linux System Design and Development”, Auerbach Publications

**REFERENCES:**

1. Christopher Hallinan, “Embedded Linux Primer: A Practical Real World Approach”, Prentice Hall, 2nd Edition, 2010.
2. Derek Molloy, “Exploring Beagle Bone: Tools and Techniques for Building with Embedded Linux”, Wiley, 1st Edition, 2014

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**M.TECH.- I YEAR- I SEMESTER  
EMBEDDED SYSTEMS**

**PROGRAMMING LANGUAGES FOR EMBEDDED SOFTWARE (PE- I)**

**Course Outcomes:** At the end of this course, students will be able to

1. Write an embedded C application of moderate complexity.
2. Develop and analyze algorithms in C++.
3. Differentiate interpreted languages from compiled languages.

**UNIT-I**

Embedded 'C' Programming

- Bitwise operations, Dynamic memory allocation, OS services
- Linked stack and queue, Sparse matrices, Binary tree
- Interrupt handling in C, Code optimization issues
- Writing LCD drives, LED drivers, Drivers for serial port communication
- Embedded Software Development Cycle and Methods (Waterfall, Agile)

**UNIT-II**

CPP Programming: 'cin', 'cout', formatting and I/O manipulators, new and delete operators, Defining a class, data members and methods, 'this' pointer, constructors, destructors, friend function, dynamic memory allocation

**UNIT-III**

Overloading and Inheritance: Need of operator overloading, overloading the assignment, overloading using friends, type conversions, single inheritance, base and derived classes, friend classes, types of inheritance, hybrid inheritance, multiple inheritance, virtual base class, polymorphism, virtual functions,

**UNIT-IV**

Templates: Function template and class template, member function templates and template arguments, Exception Handling: syntax for exception handling code: try-catch-throw, Multiple Exceptions.

**UNIT-V**

Scripting Languages Overview of Scripting Languages – PERL, CGI, VB Script, Java Script.

PERL: Operators, Statements Pattern Matching etc. Data Structures, Modules, Objects, Tied Variables, Inter process Communication Threads, Compilation & Line Interfacing.

**TEXTBOOKS:**

1. Michael J. Pont, "Embedded C", Pearson Education, 2<sup>nd</sup> Edition, 2008
2. Randal L. Schwartz, "Learning Perl", O'Reilly Publications, 6<sup>th</sup> Edition 2011

**REFERENCES:**

1. A. Michael Berman, "Data structures via C++", Oxford University Press, 2002
2. Robert Sedgewick, "Algorithms in C++", Addison Wesley Publishing Company, 1999
3. Abraham Silberschatz, Peter B, Greg Gagne, "Operating System Concepts", John Willey & Sons, 2005

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EMBEDDED SYSTEMS**

**AI & MACHINE LEARNING (PE- I)**

**UNIT - I**

Supervised Learning (Regression/Classification)

Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods

Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

**UNIT-II**

Unsupervised Learning

Clustering: K-means/Kernel K-means

Dimensionality Reduction: PCA and kernel PCA

Matrix Factorization and Matrix Completion

Generative Models (mixture models and latent factor models)

**UNIT-III**

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

**UNIT-IV**

Biological foundations to intelligent Systems: Artificial Neural Networks.

Single layer and Multilayer Feed Forward NN, LMS and Back Propagation. Algorithm, Feedback networks and Radial Basis Function Networks

**UNIT-V**

Fuzzy Logic, Knowledge Representation and Inference Mechanism, Defuzzification Methods Fuzzy Neural Networks and some algorithms to learn the parameters of the network like GA

**TEXTBOOKS:**

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
4. J M Zurada , "An Introduction to ANN", Jaico Publishing House
5. Simon Haykins, "Neural Networks", Prentice Hall



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**COMPUTER VISION (PE- I)**

**Course Outcomes:** At the end of this course, students will be able to

1. Study the image formation models and feature extraction for computer vision
2. Identify the segmentation and motion detection and estimation techniques
3. Develop small applications and detect the objects in various applications

**UNIT-I**

**Image Formation Models** Monocular imaging system • Orthographic & Perspective Projection • Camera model and Camera calibration • Binocular imaging systems, Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. Apparel, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. Apparel, Stereo vision

**UNIT-II**

**Feature Extraction:** Image representations (continuous and discrete) • Edge detection, Edge linking, corner detection, texture, binary shape analysis, boundary pattern analysis, circle and ellipse detection, Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

**UNIT-III**

**Shape Representation and Segmentation: Deformable** curves and surfaces • Snakes and active contours Level set representations • Fourier and wavelet descriptors • Medial representations • Multi-resolution analysis, Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation

**UNIT-IV**

**Motion Detection and Estimation** • Regularization theory • Optical computation • Stereo Vision Motion estimation, Background Subtraction and Modelling, Optical Flow, KLT, Spatio- Temporal Analysis, Dynamic Stereo; Motion parameter estimation • Structure from motion, Motion Tracking in Video

**UNIT-V**

**Object recognition** • Hough transforms and other simple object recognition methods • Shape correspondence and shape matching • Principal component analysis • Shape priors for recognition

**REFERENCES:**

1. D. Forsyth and J. Ponce, "Computer Vision - A modern approach", 2<sup>nd</sup> Edition, Pearson Prentice Hall, 2012
2. Szeliski, Richard, "Computer Vision: Algorithms and Applications", 1<sup>st</sup> Edition, Springer-Verlag London Limited, 2011.
3. Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", 2<sup>nd</sup> Edition, Cambridge University Press, 2004.
4. K. Fukunaga, "Introduction to Statistical Pattern Recognition", 2<sup>nd</sup> Edition, Morgan Kaufmann, 1990.
5. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", 3<sup>rd</sup> Edition,

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Prentice Hall, 2008.

6. B. K. P. Horn, "Robot Vision", 1<sup>st</sup> Edition, McGraw-Hill, 1986.
7. E. R. Davies "Computer and Machine Vision: Theory, Algorithms, Practicalities", 4th Edition, Elsevier Inc,2012.

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**COMMUNICATION BUSES AND INTERFACES (PE - II)**

**Course Outcomes:** At the end of the course, students will be able to:

1. Select a particular serial bus suitable for a particular application.
2. Develop APIs for configuration, reading and writing data onto serial bus.
3. Design and develop peripherals that can be interfaced to desired serial bus.

**UNIT-I**

Serial Busses - Physical interface, Data and Control signals, features, limitations and applications of RS232, RS485, I<sup>2</sup>C, SPI

**UNIT-II**

CAN - Architecture, Data transmission, Layers, Frame formats, applications

**UNIT-III**

PCIe - Revisions, Configuration space, Hardware protocols, applications

**UNIT-IV**

USB - Transfer types, enumeration, Descriptor types and contents, Device driver

**UNIT-V**

Data Streaming Serial Communication Protocol - Serial Front Panel Data Port (SFPDP) using fiber optic and copper cable

**TEXTBOOKS:**

1. Jan Axelson, "Serial Port Complete - COM Ports, USB Virtual Com Ports, and Ports for Embedded Systems", Lakeview Research, 2<sup>nd</sup> Edition
2. Jan Axelson, "USB Complete", Penram Publications
3. Mike Jackson, Ravi Budruk, "PCI Express Technology", Mindshare Press
4. Wilfried Voss, "A Comprehensible Guide to Controller Area Network", Copperhill Media Corporation, 2<sup>nd</sup> Edition, 2005.
5. Serial Front Panel Draft Standard VITA 17.1 – 200x
6. Technical references on [www.can-cia.org](http://www.can-cia.org), [www.pcisig.com](http://www.pcisig.com), [www.usb.org](http://www.usb.org)

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**PARALLEL PROCESSING (PE - II)**

**Course Outcomes:** At the end of this course, students will be able to

1. Identify limitations of different architectures of computer
2. Analysis quantitatively the performance parameters for different architectures
3. Investigate issues related to compilers and instruction set based on type of architectures.

**UNIT-I**

Overview of Parallel Processing and Pipelining, Performance analysis, Scalability, Principles and implementation of Pipelining, Classification of pipelining processors, Advanced pipelining techniques, Software pipelining

**UNIT-II**

VLIW processors: Case study: Superscalar Architecture- Pentium, Intel Itanium Processor, Ultra SPARC, MIPS on FPGA, Vector and Array Processor, FFT Multiprocessor Architecture

**UNIT-III**

Multithreaded Architecture, Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions.

**UNIT-IV**

**Parallel Programming Techniques:** Message passing program development, Synchronous and asynchronous message passing, Shared Memory Programming, Data Parallel Programming, Parallel Software Issues

**UNIT-V**

Operating systems for multiprocessors systems Customizing applications on parallel processing platforms

**TEXTBOOKS:**

1. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing", MGH International Edition
2. Kai Hwang, "Advanced Computer Architecture", TMH

**REFERENCES:**

1. V. Rajaraman, L. Sivaram Murthy, "Parallel Computers", PHI.
2. William Stallings, "Computer Organization and Architecture, Designing for performance" Prentice Hall, Sixth edition
3. Kai Hwang, Zhiwei Xu, "Scalable Parallel Computing", MGH
4. David Harris and Sarah Harris, "Digital Design and Computer Architecture", Morgan Kaufmann.

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**ADVANCED COMPUTER ARCHITECTURE (PE – II)**

**UNIT- I**

**Fundamentals of Computer Design:** Fundamentals of Computer design, Changing faces of computing and task of computer designer, Technology trends, Cost price and their trends, measuring and reporting performance, quantitative principles of computer design, Amdahl's law.

Instruction set principles and examples- Introduction, classifying instruction set- memory addressing-type and size of operands, operations in the instruction set.

**UNIT – II**

**Pipelines:** Introduction, basic RISC instruction set, Simple implementation of RISC instruction set, Classic five stage pipe line for RISC processor, Basic performance issues in pipelining, Pipeline hazards, Reducing pipeline branch penalties.

**Memory Hierarchy Design:** Introduction, review of ABC of cache, Cache performance, Reducing cache miss penalty, Virtual memory.

**UNIT - III**

**Instruction Level Parallelism the Hardware Approach:** Instruction-Level parallelism, Dynamic scheduling, Dynamic scheduling using Tomasulo's approach, Branch prediction, high performance instruction delivery- hardware based speculation.

**ILP Software Approach:** Basic compiler level techniques, static branch prediction, VLIW approach, Exploiting ILP, Parallelism at compile time, Cross cutting issues -Hardware verses Software.

**UNIT – IV**

**Multi Processors and Thread Level Parallelism:** Multi Processors and Thread level Parallelism- Introduction, Characteristics of application domain, Systematic shared memory architecture, Distributed shared – memory architecture, Synchronization.

**UNIT – V**

**Inter Connection and Networks:** Introduction, Interconnection network media, Practical issues in interconnecting networks, Examples of inter connection, Cluster, Designing of clusters.

**Intel Architecture:** Intel IA- 64 ILP in embedded and mobile markets Fallacies and pit falls

**TEXT BOOK:**

1. John L. Hennessy, David A. Patterson, "Computer Architecture: A Quantitative Approach", 3rd Edition, Elsevier.

**REFERENCE BOOKS**

1. John P. Shen and Miikko H. Lipasti, "Modern Processor Design: Fundamentals of Super Scalar Processors", 2002, Beta Edition, McGraw-Hill
2. Kai Hwang, Faye A. Brigs., "Computer Architecture and Parallel Processing", Mc Graw Hill.
3. Dezsó Sima, Terence Fountain, Peter Kacsuk, "Advanced Computer Architecture - A Design Space Approach", Pearson Education.

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**MICROCONTROLLERS AND PROGRAMMABLE DIGITAL SIGNAL PROCESSORS LAB**  
**(Lab – I)**

**Course Outcomes:** At the end of the laboratory work, students will be able to:

1. Install, configure and utilize tool sets for developing applications based on ARM processor core SoC and DSP processor.
2. Develop prototype codes using commonly available on and off chip peripherals on the Cortex M3 and DSP development boards.

**List of Assignments:**

**Part A)** Experiments to be carried out on Cortex-M3 development boards and using GNU tool- chain

1. Blink an LED with software delay, delay generated using the SysTick timer.
2. System clock real time alteration using the PLL modules.
3. Control intensity of an LED using PWM implemented in software and hardware.
4. Control an LED using switch by polling method, by interrupt method and flash the LED once every five switch presses.
5. UART Echo Test.
6. Take analog readings on rotation of rotary potentiometer connected to an ADC channel.
7. Temperature indication on an RGB LED.
8. Mimic light intensity sensed by the light sensor by varying the blinking rate of an LED.
9. Evaluate the various sleep modes by putting core in sleep and deep sleep modes.
10. System reset using watchdog timer in case something goes wrong.
11. Sample sound using a microphone and display sound levels on LEDs.

**Part B)** Experiments to be carried out on DSP C6713 evaluation kits and using Code Composer Studio (CCS)

12. To develop an assembly code and C code to compute Euclidian distance between any two points
13. To develop assembly code and study the impact of parallel, serial and mixed execution
14. To develop assembly and C code for implementation of convolution operation
15. To design and implement filters in C to enhance the features of given input sequence/signal

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**EMBEDDED SYSTEMS**

**SYSTEM DESIGN WITH EMBEDDED LINUX LAB (Lab – II)**

**List of Experiments:**

1. **Functional Testing Of Devices:** Flashing the OS on to the device into a stable functional state by porting desktop environment with necessary packages.
2. **Exporting Display On To Other Systems:** Making use of available laptop/desktop displays as a display for the device using SSH client & X11 display server.
3. **GPIO Programming:** Programming of available GPIO pins of the corresponding device using native programming language. Interfacing of I/O devices like LED/Switch etc., and testing the functionality.
4. **Interfacing Chronos eZ430:** Chronos device is a programmable texas instruments watch which can be used for multiple purposes like PPT control, Mouse operations etc., Exploit the features of the device by interfacing with devices.
5. **ON/OFF Control Based On Light Intensity:** Using the light sensors, monitor the surrounding light intensity & automatically turn ON/OFF the high intensity LED's by taking some pre-defined threshold light intensity value.
6. **Battery Voltage Range Indicator:** Monitor the voltage level of the battery and indicating the same using multiple LED's (for ex: for 3V battery and 3 led's, turn on 3 led's for 2-3V, 2 led's for 1-2V, 1 led for 0.1-1V & turn off all for 0V)
7. **Dice Game Simulation:** Instead of using the conventional dice, generate a random value similar to dice value and display the same using a 16X2 LCD. A possible extension could be to provide the user with option of selecting single or double dice game.
8. **Displaying RSS News Feed On Display Interface:** Displaying the RSS news feed headlines on a LCD display connected to device. This can be adapted to other websites like twitter or other information websites. Python can be used to acquire data from the internet.
9. **Porting Openwrt To the Device:** Attempt to use the device while connecting to a wifi network using a USB dongle and at the same time providing a wireless access point to the dongle.
10. **Hosting a website on Board:** Building and hosting a simple website(static/dynamic) on the device and make it accessible online. There is a need to install server (eg: Apache) and thereby host the website.
11. **Webcam Server:** Interfacing the regular usb webcam with the device and turn it into fully functional IP webcam & test the functionality.
12. **FM Transmission:** Transforming the device into a regular fm transmitter capable of transmitting audio at desired frequency (generally 88-108 Mhz)

Note: Devices mentioned in the above lists include Arduino, **Raspberry Pi**, Beaglebone

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**RESEARCH METHODOLOGY AND IPR**

**Prerequisite:** None

**Course Objectives:**

- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

**Course Outcomes:** At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

**UNIT-I:**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

**UNIT-II:**

Effective literature studies approaches, analysis, Plagiarism, Research ethics

**UNIT-III:**

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

**UNIT-IV:**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

**UNIT-V:**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information



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and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

**TEXT BOOKS:**

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

**REFERENCES:**

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

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**M. Tech. (EMBEDDED SYSTEMS)**

**ENGLISH FOR RESEARCH PAPER WRITING (Audit Course - I & II)**

**Prerequisite:** None

**Course objectives:** Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

**UNIT-I:**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

**UNIT-II:**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

**UNIT-III:**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

**UNIT-IV:**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

**UNIT-V:**

skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

**TEXT BOOKS/ REFERENCES:**

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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**M. Tech. (EMBEDDED SYSTEMS)**

**DISASTER MANAGEMENT (Audit Course - I & II)**

**Prerequisite:** None

**Course Objectives:** Students will be able to

- learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches,
- planning and programming in different countries, particularly their home country or the countries they work in

**UNIT-I:**

**Introduction:**

Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

**Disaster Prone Areas in India:**

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

**UNIT-II:**

**Repercussions of Disasters and Hazards:**

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

**UNIT-III:**

**Disaster Preparedness and Management:**

Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

**UNIT-IV:**

**Risk Assessment Disaster Risk:**

Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

**UNIT-V:**

**Disaster Mitigation:**

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

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**TEXT BOOKS/ REFERENCES:**

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "New Royal book Company.
2. Sahni, Pardeep Et. Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi.

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M. Tech. (EMBEDDED SYSTEMS)**

**SANSKRIT FOR TECHNICAL KNOWLEDGE (Audit Course - I & II)**

**Prerequisite:** None

**Course Objectives:**

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

**Course Outcomes:** Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood
- Being a logical language will help to develop logic in students

**UNIT-I:**

Alphabets in Sanskrit,

**UNIT-II:**

Past/Present/Future Tense, Simple Sentences

**UNIT-III:**

Order, Introduction of roots,

**UNIT-IV:**

Technical information about Sanskrit Literature

**UNIT-V:**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

**TEXT BOOKS/ REFERENCES:**

1. "Abhyastakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

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**M. Tech. (EMBEDDED SYSTEMS)**

**VALUE EDUCATION (Audit Course - I & II)**

**Prerequisite:** None

**Course Objectives:** Students will be able to

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

**Course outcomes:** Students will be able to

- Knowledge of self-development
- Learn the importance of Human values
- Developing the overall personality

**UNIT-I:**

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

**UNIT-II:**

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

**UNIT-III:**

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness.

**UNIT-IV:**

Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

**UNIT-V:**

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation, Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

**TEXT BOOKS/ REFERENCES:**

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

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**M. Tech. (EMBEDDED SYSTEMS)**

**CONSTITUTION OF INDIA (Audit Course - I & II)**

**Prerequisite:** None

**Course Objectives:** Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

**Course Outcomes:** Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

**UNIT-I:**

**History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working), **Philosophy of the Indian Constitution:** Preamble, Salient Features.

**UNIT-II:**

**Contours of Constitutional Rights & Duties:** Fundamental Rights Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

**UNIT-III:**

**Organs of Governance:** Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions.

**UNIT-IV:**

**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

**UNIT-V:**

**Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

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**TEXT BOOKS/ REFERENCES:**

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.



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**M. Tech. (EMBEDDED SYSTEMS)**

**PEDAGOGY STUDIES (Audit Course - I & II)**

**Prerequisite:** None

**Course Objectives:** Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

**Course Outcomes:** Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

**UNIT-I:**

**Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.

**UNIT-II:**

**Thematic overview:** Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

**UNIT-III:**

Evidence on the effectiveness of pedagogical practices, Methodology for the indepth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the scho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

**UNIT-IV:**

**Professional development:** alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

**UNIT-V:**

**Research gaps and future directions:** Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

**TEXT BOOKS/ REFERENCES:**

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeamong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

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4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? *International Journal Educational Development*, 33 (3): 272–282.
5. Alexander RJ (2001) *Culture and pedagogy: International comparisons in primary education*. Oxford and Boston: Blackwell.
6. Chavan M (2003) *Read India: A mass scale, rapid, 'learning to read' campaign*.
7. [www.pratham.org/images/resource%20working%20paper%202.pdf](http://www.pratham.org/images/resource%20working%20paper%202.pdf).

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**M. Tech. (EMBEDDED SYSTEMS)**

**STRESS MANAGEMENT BY YOGA (Audit Course - I & II)**

**Prerequisite:** None

**Course Objectives:**

- To achieve overall health of body and mind
- To overcome stress

**Course Outcomes:** Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

**UNIT-I:**

Definitions of Eight parts of yog. (Ashtanga)

**UNIT-II:**

Yam and Niyam.

**UNIT-III:**

Do`s and Don`t`s in life.

- i) Ahinsa, satya, astheya, bramhacharya and aparigraha
- ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

**UNIT-IV:**

Asan and Pranayam

**UNIT-V:**

- i) Various yog poses and their benefits for mind & body
- ii) Regularization of breathing techniques and its effects-Types of pranayam

**TEXT BOOKS/ REFERENCES:**

1. 'Yogic Asanas for Group Training-Part-I': Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

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**M. Tech. (EMBEDDED SYSTEMS)**

**PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS  
(Audit Course - I & II)**

**Prerequisite:** None

**Course Objectives:**

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

**Course Outcomes:** Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

**UNIT-I:**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

**UNIT-II:**

Neetisatakam-Holistic development of personality

- Verses- 52,53,59 (don't's)
- Verses- 71,73,75,78 (do's)

**UNIT-III:**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

**UNIT-IV:**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

**UNIT-V:**

- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

**TEXT BOOKS/ REFERENCES:**

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.



**MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT  
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**M.TECH.- I YEAR- II SEMESTER  
EMBEDDED SYSTEMS**

**Course Code:1925504**

**L T P C  
3 0 0 3**

**RTL SIMULATION AND SYNTHESIS WITH PLDs**

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

1. Familiarity of Finite State Machines, RTL design using reconfigurable logic.
2. Design and develop IP cores and Prototypes with performance guarantees
3. Use EDA tools like Cadence, Mentor Graphics and Xilinx

**UNIT-I**

Top down approach to design, Design of FSMs (Synchronous and asynchronous), Static timing analysis, Meta-stability, Clock issues, Need and design strategies for multi-clock domain designs.

**UNIT-II**

Design entry by Verilog/VHDL/FSM, Verilog AMS.

**UNIT-III**

Programmable Logic Devices, Introduction to ASIC Design Flow, FPGA, SoC, Floor planning, Placement, Clock tree synthesis, Routing, Physical verification, Power analysis, ESD protection.

**UNIT-IV**

Design for performance, Low power VLSI design techniques. Design for testability.

**UNIT-V**

IP and Prototyping: IP in various forms: RTL Source code, Encrypted Source code, Soft IP, Netlist, Physical IP, Use of external hard IP during prototyping

**TEXTBOOKS:**

1. Richard S. Sandige, "Modern Digital Design", MGH, International Editions.
2. Donald D Givone, "Digital principles and Design", TMH

**REFERENCES:**

1. Charles Roth, Jr. and Lizy K John, "Digital System Design using VHDL", Cengage Learning.
2. Samir Palnitkar, "Verilog HDL, a guide to digital design and synthesis", Prentice Hall.
3. Doug Amos, Austin Lesea, Rene Richter, "FPGA based prototyping methodology manual", Xilinx
4. Bob Zeidman, "Designing with FPGAs & CPLDs", CMP Books.



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**M.TECH.- I YEAR- II SEMESTER  
EMBEDDED SYSTEMS**

**Course Code:1925505**

**L T P C  
3 0 0 3**

**ADVANCED DIGITAL SIGNAL PROCESSING**

**Course Outcomes:** At the end of this course, students will be able to

1. To understand theory of different filters and algorithms
2. To understand theory of multirate DSP, solve numerical problems and write algorithms
3. To understand theory of prediction and solution of normal equations
4. To know applications of DSP at block level.

**UNIT-I**

Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design & structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, parallel realization of IIR.

**UNIT-II**

Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in subband coding.

**UNIT-III**

Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

**UNIT-IV**

Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm

**UNIT-V**

Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation.

**TEXTBOOKS:**

1. J. G. Proakis and D.G. Manolakis, "Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1<sup>st</sup> Edition, John Wiley and Sons Ltd, 1999.

**REFERENCES:**

1. Bruce W. Suter, "Multirate and Wavelet Signal Processing", 1<sup>st</sup> Edition, Academic Press, 1997.
2. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.
3. S. Haykin, "Adaptive Filter Theory", 4<sup>th</sup> Edition, Prentice Hall, 2001.
4. D. G. Manolakis, V. K. Ingle and S. M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000



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**M.TECH.- I YEAR- II SEMESTER  
EMBEDDED SYSTEMS**

**Course Code:1925512**

**L T P C  
3 0 0 3**

**IOT AND ITS APPLICATIONS (PE – III)**

**Course Outcomes:** At the end of this course, students will be able to

1. Understand the concept of IOT and M2M
2. Study IOT architecture and applications in various fields
3. Study the security and privacy issues in IOT.

**UNIT-I**

IoT & Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

**UNIT-II**

M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

**UNIT-III**

IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model-Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

**UNIT-IV**

IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

**UNIT-V**

Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues,

**TEXTBOOKS**

1. Vijay Madiseti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1<sup>st</sup> Edition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1<sup>st</sup> Edition, Apress Publications, 2013.
3. Cuno Pfister, "Getting Started with the Internet of Things", O Reilly Media, 2011.



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**M.TECH.- I YEAR- II SEMESTER  
EMBEDDED SYSTEMS**

**Course Code:1925513**

**L T P C  
3 0 0 3**

**VLSI SIGNAL PROCESSING (PE-III)**

**Course Outcomes:** On successful completion of the module, students will be able to:

1. Ability to modify the existing or new DSP architectures suitable for VLSI.
2. Understand the concepts of folding and unfolding algorithms and applications.
3. Ability to implement fast convolution algorithms.
4. Low power design aspects of processors for signal processing and wireless applications.

**UNIT -I**

**Introduction to DSP:** Typical DSP algorithms, DSP algorithms benefits, Representation of DSP algorithms

**Pipelining and Parallel Processing:** Introduction, Pipelining of FIR Digital filters, Parallel Processing, Pipelining and Parallel Processing for Low Power

**Retiming:** Introduction, Definitions and Properties, Solving System of Inequalities, Retiming Techniques

**UNIT –II**

**Folding and Unfolding: Folding-** Introduction, Folding Transform, Register minimization Techniques, Register minimization in folded architectures, folding of Multirate systems

**Unfolding-** Introduction, An Algorithm for Unfolding, Properties of Unfolding, critical Path, Unfolding and Retiming, Applications of Unfolding

**UNIT -III**

**Systolic Architecture Design:** Introduction, Systolic Array Design Methodology, FIR Systolic Arrays, Selection of Scheduling Vector, Matrix Multiplication and 2D Systolic Array Design, Systolic Design for Space Representations contain Delays.

**UNIT -IV**

**Fast Convolution:** Introduction – Cook-Toom Algorithm – Winograd algorithm – Iterated Convolution – Cyclic Convolution – Design of Fast Convolution algorithm by Inspection

**UNIT -V**

**Low Power Design:** Scaling Vs Power Consumption, Power Analysis, Power Reduction techniques, Power Estimation Approaches

**Programmable DSP:** Evaluation of Programmable Digital Signal Processors, DSP Processors for Mobile and Wireless Communications, Processors for Multimedia Signal Processing

**TEXT BOOKS:**

1. VLSI Digital Signal Processing- System Design and Implementation – Keshab K. Parthi, Wiley Inter Science, 1998.
2. VLSI and Modern Signal processing – Kung S. Y, H. J. White House, T. Kailath, Prentice Hall, 1985.

**REFERENCES:**

1. Design of Analog – Digital VLSI Circuits for Telecommunications and Signal Processing – Jose E. France, Yannis Tsividis, Prentice Hall, 1994.
2. VLSI Digital Signal Processing – Medisetti V. K, IEEE Press (NY), 1995.





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**M.TECH.- I YEAR- II SEMESTER  
EMBEDDED SYSTEMS**

Course Code:1925514

**L T P C  
3 0 0 3**

**SOC ARCHITECTURE (PE-III)**

**UNIT – I**

**Introduction to the System Approach:** System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

**UNIT – II**

**Processors:** Introduction , Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

**UNIT – III**

**Memory Design for SOC:** Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation , SOC Memory System, Models of Simple Processor – memory interaction.

**UNIT - IV**

**Interconnect Customization and Configuration:** Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses , Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance-Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.

**UNIT – V**

**Application Studies / Case Studies:** SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression.

**TEXT BOOKS:**

1. Michael J. Flynn and Wayne Luk, "Computer System Design System-on-Chip", Wiley India Pvt. Ltd.
2. Steve Furber, "ARM System on Chip Architecture ", 2<sup>nd</sup> Edition, 2000, Addison Wesley Professional.

**REFERENCE BOOKS:**

1. Ricardo Reis, ""Design of System on a Chip: Devices and Components", 1<sup>st</sup> Edition, 2004, Springer
2. Jason Andrews, "Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology)", Newnes, BK and CDROM.
3. Prakash Rashinkar, Peter Paterson and Leena Singh L, "System on Chip Verification – Methodologies and Techniques", 2001, Kluwer Academic Publishers.



**MARRI LAXMAN REDDY INSTITUTE OF TECHNOLOGY AND MANAGEMENT  
(AUTONOMOUS)**

**M.TECH.- I YEAR- II SEMESTER  
EMBEDDED SYSTEMS**

Course Code:1925515

**L T P C  
3 0 0 3**

**HARDWARE AND SOFTWARE CO-DESIGN (PE-IV)**

**Course Outcomes**

1. To acquire the knowledge on various models of Co-design.
2. To explore the interrelationship between Hardware and software in a embedded system
3. To acquire the knowledge of firmware development process and tools during Co-design.
4. Understand validation methods and adaptability.

**UNIT I**

**Co- Design Issues:** Co- Design Models, Architectures, Languages, A Generic Co-design Methodology.

**Co- Synthesis Algorithms:** Hardware software synthesis algorithms: hardware – software partitioning distributed system co-synthesis.

**UNIT II**

**Prototyping and Emulation:** Prototyping and emulation techniques, prototyping and emulation environments, future developments in emulation and prototyping architecture specialization techniques, system communication infrastructure.

**Target Architectures:** Architecture Specialization techniques, System Communication infrastructure, Target Architecture and Application System classes, Architecture for control dominated systems (8051-Architectures for High performance control), Architecture for Data dominated systems (ADSP21060, TMS320C60), Mixed Systems.

**UNIT III**

**Compilation Techniques and Tools for Embedded Processor Architectures:** Modern embedded architectures, embedded software development needs, compilation technologies, practical consideration in a compiler development environment.

**UNIT IV**

**Design Specification and Verification:** Design, co-design, the co-design computational model, concurrency coordinating concurrent computations, interfacing components, design verification, implementation verification, verification tools, interface verification.

**UNIT V**

**Languages for System – Level Specification and Design-I:** System – level specification, design representation for system level synthesis, system level specification languages,

**Languages for System – Level Specification and Design-II:** Heterogeneous specifications and multi-language co-simulation, the cosymsa system and lycos system.

**REFERENCES:**

1. Hardware / Software Co- Design Principles and Practice – Jorgen Staunstrup, Wayne Wolf – Springer, 2009.
2. Hardware / Software Co- Design - Giovanni De Micheli, Mariagiovanna Sami, Kluwer Academic Publishers, 2002.
3. A Practical Introduction to Hardware/Software Co-design -Patrick R. Schaumont, Springer, 2010



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**M.TECH.- I YEAR- II SEMESTER  
EMBEDDED SYSTEMS**

Course Code:1925516

**L T P C  
3 0 0 3**

**NETWORK SECURITY AND CRYPTOGRAPHY (PE-IV)**

**Course Outcomes:** At the end of the course, students will be able to:

1. Identify and utilize different forms of cryptography techniques.
2. Incorporate authentication and security in the network applications.
3. Distinguish among different types of threats to the system and handle the same.

**UNIT-I:**

**Security:** Need, security services, Attacks, OSI Security Architecture, one time passwords, Model for Network security, Classical Encryption Techniques like substitution ciphers, Transposition ciphers, Cryptanalysis of Classical Encryption Techniques.

**UNIT-II**

**Number Theory:** Introduction, Fermat's and Euler's Theorem, The Chinese Remainder Theorem, Euclidean Algorithm, Extended Euclidean Algorithm, and Modular Arithmetic.

**UNIT-III**

**Private-Key (Symmetric) Cryptography:** Block Ciphers, Stream Ciphers, RC4 Stream cipher, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Triple DES, RC5, IDEA, Linear and Differential Cryptanalysis.

**UNIT-IV**

**Public-Key (Asymmetric) Cryptography:** RSA, Key Distribution and Management, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message Authentication Code, hash functions, message digest algorithms: MD4 MD5, Secure Hash algorithm, RIPEMD-160, HMAC.

**UNIT-V**

**Authentication and System Security:** IP and Web Security Digital Signatures, Digital Signature Standards, Authentication Protocols, Kerberos, IP security Architecture, Encapsulating Security Payload, Key Management, Web Security Considerations, Secure Socket Layer, Secure Electronic Transaction Intruders, Intrusion Detection, Password Management, Worms, viruses, Trojans, Virus Countermeasures, Firewalls, Trusted Systems.

**TEXT BOOKS:**

1. William Stallings, "Cryptography and Network Security, Principles and Practices", Pearson Education, 3<sup>rd</sup> Edition.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security, Private Communication in a Public World", Prentice Hall, 2<sup>nd</sup> Edition

**REFERENCES:**

1. Christopher M. King, Ertem Osmanoglu, Curtis Dalton, "Security Architecture, Design Deployment and Operations", RSA Pres,
2. Stephen Northcutt, Leny Zeltser, Scott Winters, Karen Kent, and Ronald W. Ritchey, "Inside Network Perimeter Security", Pearson Education, 2<sup>nd</sup> Edition
3. Richard Bejtlich, "The Practice of Network Security Monitoring: Understanding Incident Detection and Response", William Pollock Publisher, 2013.



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**M.TECH.- I YEAR- II SEMESTER  
EMBEDDED SYSTEMS**

**Course Code:1925517**

**L T P C  
3 0 0 3**

**PHYSICAL DESIGN AUTOMATION (PE-IV)**

**Course Outcomes:** At the end of the course, students will be able to:

1. Study automation process for VLSI System design.
2. Understanding of fundamentals for various physical design CAD tools.
3. Develop and enhance the existing algorithms and computational techniques for physical design process of VLSI systems.

**UNIT- I**

Introduction to VLSI Physical Design Automation: Design Representation, VLSI Design Styles, and VLSI Physical Design automation.

**UNIT- II**

Partitioning, Floor planning, Pin Assignment, Standard cell, Performance issues in circuit layout, delay models, Layout styles.

**UNIT- III**

**Placement:** Problem formulation, classification, Simulation based placement algorithms, Partitioning based placement algorithms, Time driven and performance driven placement.

**UNIT- IV**

**Global routing:** Problem formulation, classification of global routing, Maze routing algorithms, Line-Probe algorithms, and shortest path based algorithms, Steiner Tree based algorithms, Integer programming based approach, Performance driven routing.

Detailed Routing: Problem formulation, classification, Single layer, two layer, three layer and Multi-Layer channel routing, Algorithms, Switch box routing.

**UNIT- V**

**Over the Cell Routing** - Single layer and two-layer routing: Over the cell routing, Two Layer, Three Layer and Multi-Layer OTC Routing.

Via Minimization: Constraint and Unconstrained via minimization.

**Clock and Power Routing:** Clocking schemes, design considerations for the clock ,Problem formulation, Clock routing algorithms, Skew and Delay reduction by Pin Assignment, Multiple clock routing, Power and Ground Routing

**TEXT BOOKS**

1. Algorithms for VLSI Physical Design Automation – Naveed Sherwani, 3rd Ed., 2005,
2. Algorithms for VLSI Design Automation, S.H.Gerez, 1999, WILEY Student Edition, John wiley & Sons (Asia) Pvt. Ltd.

**REFERENCE BOOKS:**

1. Computer Aided Logical Design with Emphasis on VLSI – Hill & Peterson, 1993, Wiley.
2. Modern VLSI Design: Systems on silicon – Wayne Wolf, 2nd ed., 1998, Pearson Education Asia



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**M.TECH.- I YEAR- II SEMESTER  
EMBEDDED SYSTEMS**

**Course Code:1925523**

**L T P C  
0 0 3 2**

**RTL SIMULATION AND SYNTHESIS WITH PLDS LAB**

**Course Outcomes:** At the end of the laboratory work, students will be able to:

1. Identify, formulate, solve and implement problems in signal processing, communication systems etc using RTL design tools.
2. Use EDA tools like Cadence, Mentor Graphics and Xilinx or equivalent tools

**List of Experiments:**

1. Verilog implementation of 8:1 Mux/Demux, Full Adder, 8-bit Magnitude comparator, Encoder/decoder, Priority encoder, D-FF, 4-bit Shift registers (SISO, SIPO, PISO, bidirectional), 3-bit Synchronous Counters, Binary to Gray converter, Parity generator.
2. Sequence generator/detectors, Synchronous FSM – Mealy and Moore machines.
3. Vending machines - Traffic Light controller, ATM, elevator control.
4. PCI Bus & arbiter and downloading on FPGA.
5. UART/ USART implementation in Verilog.
6. Realization of single port SRAM in Verilog.
7. Verilog implementation of Arithmetic circuits like serial adder/ subtractor, parallel adder/subtractor, serial/parallel multiplier.
8. Discrete Fourier transform/Fast Fourier Transform algorithm in Verilog.



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**M.TECH.- I YEAR- II SEMESTER  
EMBEDDED SYSTEMS**

**Course Code:1925524**

**L T P C  
0 0 3 2**

**ADVANCED DIGITAL SIGNAL PROCESSING LAB (Lab – IV)**

**Note:** Minimum of 10 Experiments have to be conducted

**List of Experiments:**

1. Basic Operations on Signals, Generation of Various Signals and finding its FFT.
2. Program to verify Decimation and Interpolation of a given Sequences.
3. Program to Convert CD data into DVD data
4. Generation of Dual Tone Multiple Frequency (DTMF) Signals
5. Plot the Periodogram of a Noisy Signal and estimate PSD using Periodogram and Modified Periodogram methods
6. Estimation of Power Spectrum using Bartlett and Welch methods
7. Verification of Autocorrelation Theorem
8. Parametric methods (Yule-Walker and Burg) of Power Spectrum Estimation
9. Estimation of data series using Nth order Forward Predictor and comparing to the Original Signal
10. Design of LPC filter using Levinson-Durbin Algorithm
11. Computation of Reflection Coefficients using Schur Algorithm
12. To study Finite Length Effects using Simulink
13. ECG signal compression
14. Design and Simulation of Notch Filter to remove 60 Hz Hum/any unwanted frequency component of given Signal (Speech/ECG)



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**M.TECH.- I YEAR- II SEMESTER  
EMBEDDED SYSTEMS**

Course Code:1925532

**L T P C  
2 0 0 0**

**CONSTITUTION OF INDIA (Audit Course - II)**

**Prerequisite:** None

**Course Objectives:** Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

**Course Outcomes:** Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

**UNIT-I:**

**History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working), **Philosophy of the Indian Constitution:** Preamble, Salient Features.

**UNIT-II:**

**Contours of Constitutional Rights & Duties:** Fundamental Rights Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

**UNIT-III:**

**Organs of Governance:** Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions.

**UNIT-IV:**

**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

**UNIT-V:**

**Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.



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**TEXT BOOKS/ REFERENCES:**

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.





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**M.TECH.- I YEAR- II SEMESTER  
EMBEDDED SYSTEMS**

**Course Code:1925533**

**L T P C  
2 0 0 0**

**PEDAGOGY STUDIES (Audit Course - II)**

**Prerequisite:** None

**Course Objectives:** Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

**Course Outcomes:** Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

**UNIT-I:**

**Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.

**UNIT-II:**

**Thematic overview:** Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

**UNIT-III:**

Evidence on the effectiveness of pedagogical practices, Methodology for the indepth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

**UNIT-IV:**

**Professional development:** alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

**UNIT-V:**

**Research gaps and future directions:** Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

**TEXT BOOKS/ REFERENCES:**

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education



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research project (MUSTER) country report 1. London: DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? *International Journal Educational Development*, 33 (3): 272–282.
5. Alexander RJ (2001) *Culture and pedagogy: International comparisons in primary education*. Oxford and Boston: Blackwell.
6. Chavan M (2003) *Read India: A mass scale, rapid, 'learning to read' campaign*.
7. [www.pratham.org/images/resource%20working%20paper%202.pdf](http://www.pratham.org/images/resource%20working%20paper%202.pdf).



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**M.TECH.- I YEAR- II SEMESTER  
EMBEDDED SYSTEMS**

**Course Code:1925534**

**L T P C  
2 0 0 0**

**STRESS MANAGEMENT BY YOGA (Audit Course - II)**

**Prerequisite:** None

**Course Objectives:**

- To achieve overall health of body and mind
- To overcome stress

**Course Outcomes:** Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

**UNIT-I:**

Definitions of Eight parts of yog. (Ashtanga)

**UNIT-II:**

Yam and Niyam.

**UNIT-III:**

Do`s and Don`t`s in life.

- i) Ahinsa, satya, astheya, bramhacharya and aparigraha
- ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

**UNIT-IV:**

Asan and Pranayam

**UNIT-V:**

- i) Various yog poses and their benefits for mind & body
- ii) Regularization of breathing techniques and its effects-Types of pranayam

**TEXT BOOKS/ REFERENCES:**

1. 'Yogic Asanas for Group Tarining-Part-I': Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata



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**M.TECH.- I YEAR- II SEMESTER  
EMBEDDED SYSTEMS**

**Course Code:1925535**

**L T P C  
2 0 0 0**

**PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS  
(Audit Course - II)**

**Prerequisite:** None

**Course Objectives:**

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

**Course Outcomes:** Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

**UNIT-I:**

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

**UNIT-II:**

Neetisatakam-Holistic development of personality

- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

**UNIT-III:**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

**UNIT-IV:**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

**UNIT-V:**

- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

**TEXT BOOKS/ REFERENCES:**

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication



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- Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.



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**M.TECH.- II YEAR- I SEMESTER  
EMBEDDED SYSTEMS**

**Course Code:1935519**

**L T P C  
3 0 0 3**

**SCRIPTING LANGUAGES (Professional Elective-V)**

**UNIT - I**

**Introduction to Scripts and Scripting:** Characteristics and uses of scripting languages, Introduction to PERL, Names and values, Variables and assignment, Scalar expressions, Control structures, Builtin functions, Collections of Data, Working with arrays, Lists and hashes, Simple input and output, Strings, Patterns and regular expressions, Subroutines, Scripts with arguments.

**UNIT - II**

**Advanced PERL:** Finer points of Looping, Subroutines, Using Pack and Unpack, Working with files, Navigating the file system, Type globs, Eval, References, Data structures, Packages, Libraries and modules, Objects, Objects and modules in action, Tied variables, Interfacing to the operating systems, Security issues.

**UNIT - III**

**TCL:** The TCL phenomena, Philosophy, Structure, Syntax, Parser, Variables and data in TCL, Control flow, Data structures, Simple input/output, Procedures, Working with Strings, Patterns, Files and Pipes, Example code.

**UNIT - IV**

**Advanced TCL:** The eval, source, exec and up-level commands, Libraries and packages, Name spaces, Trapping errors, Event-driven programs, Making applications 'Internet-aware', 'Nutsand-bolts' internet programming, Security issues, running untrusted code, The C interface.

**UNIT - V**

**TK and Java Script:** Visual tool kits, Fundamental concepts of TK, TK by example, Events and bindings, Geometry managers, PERL-TK.

JavaScript – Object models, Design Philosophy, Versions of JavaScript, The Java Script core language, Basic concepts of Python.

**Object Oriented Programming Concepts (Qualitative Concepts Only):** Objects, Classes, Encapsulation, Data Hierarchy.

**Text Books:**

1. David Barron, "The World of Scripting Languages", Wiley Student Edition, 2010.
2. Brent Welch, Ken Jones and Jeff Hobbs., "Practical Programming in Tcl and Tk" – 4th Edition, Prentice Hall
3. Herbert Schildt, "Java the Complete Reference", 7th Edition, TMH.



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**Reference Books:**

1. Clif Flynt, "Tcl/Tk: A Developer's Guide", 2003, Morgan Kaufmann Series.
2. John Ousterhout, "Tcl and the Tk Toolkit", 2nd Edition, 2009, Kindel Edition.
3. Wojciech Kocjan and Piotr Beltowski, "Tcl 8.5 Network Programming book", PacktPublishing.
4. Bert Wheeler, "Tcl/Tk 8.5 Programming Cookbook", 2011, Packt Publishing Limited.



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**M.TECH.- II YEAR- I SEMESTER  
EMBEDDED SYSTEMS**

**Course Code: 1935520**

**L T P C  
3 0 0 3**

**MEMORY TECHNOLOGIES (Professional Elective-V)**

**Course Outcomes:** At the end of the course, students will be able to:

1. Select architecture and design semiconductor memory circuits and subsystems.
2. Identify various fault models, modes and mechanisms in semiconductor memories and their testing procedures.
3. Know, how of the state-of-the-art memory chip design

**UNIT- I**

Random Access Memory Technologies: Static Random-Access Memories (SRAMs), SRAM Cell Structures, MOS SRAM Architecture, MOS SRAM Cell and Peripheral Circuit, Bipolar SRAM, Advanced SRAM Architectures, Application Specific SRAMs.

**UNIT-II**

DRAMs, MOS DRAM Cell, BiCMOS DRAM, Error Failures in DRAM, Advanced DRAM Design and Architecture, Application Specific DRAMs. SRAM and DRAM Memory controllers.

**UNIT-III**

Non-Volatile Memories: Masked ROMs, PROMs, Bipolar & CMOS PROM, EEPROMs, Floating Gate EPROM Cell, OTP EPROM, EEPROMs, Non-volatile SRAM, Flash Memories.

**UNIT-IV**

Advanced Memory Technologies and High-density Memory Packing Technologies: Ferroelectric Random Access Memories (FRAMs), Gallium Arsenide (GaAs) FRAMs, Analog Memories, Magneto Resistive Random Access Memories (MRAMs), Experimental Memory Devices.

**UNIT-V**

Memory Hybrids (2D & 3D), Memory Stacks, Memory Testing and Reliability Issues, Memory Cards, High Density Memory Packaging.

**TEXT BOOKS:**

1. Ashok K Sharma, "Advanced Semiconductor Memories: Architectures, Designs and Applications", Wiley Interscience
2. Kiyoo Itoh, "VLSI memory chip design", Springer International Edition

**REFERENCES:**

1. Ashok K Sharma, "Semiconductor Memories: Technology, Testing and Reliability", PHI





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**M.TECH.- II YEAR- I SEMESTER  
EMBEDDED SYSTEMS**

**Course Code: 1935521**

**L T P C  
3 0 0 3**

**WIRELESS SENSOR NETWORKS (Professional Elective-V)**

**Course Objectives**

1. To acquire the knowledge about various architectures and applications of Sensor Networks.
2. To understand issues, challenges and emerging technologies for wireless sensor networks.
3. To learn about various routing protocols and MAC Protocols.
4. To understand various data gathering and data dissemination methods.
5. To Study about design principals, node architectures, hardware and software required for implementation of wireless sensor networks. .

**Course Outcomes:** Upon completion of the course, the student will be able to:

1. Analyze and compare various architectures of wireless sensor networks.
2. Understand design issues and challenges in wireless sensor networks .
3. Analyze and compare various data gathering and data dissemination methods.
4. Design, simulate and compare the performance of various routing and MAC protocol.

**UNIT -I:**

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

**UNIT –II**

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

**UNIT –III**

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

**UNIT -IV**

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 -V**

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication. Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC.



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**Text Books:**

1. Ad-Hoc Wireless Sensor Networks- C. Siva Ram Murthy, B. S. Manoj, Pearson.
2. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE.

**Reference Books:**

1. Wireless Digital Communications – Kamilo Feher, 1999, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
3. Mobile Cellular Communication – Gottapu Sasibhushana Rao, Pearson Education, 2012.
4. Wireless Communication and Networking – William Stallings, 2003, PHI.



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**M.TECH.- II YEAR- I SEMESTER  
EMBEDDED SYSTEMS**

**Course Code:1935501**

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**FUNDAMENTALS OF NANO TECHNOLOGY (Open Elective)**

**Course Outcomes:** At the end of the course, the student is able to

1. To understand the evolution of Nano systems, and various fabrication techniques.
2. Learn about nano materials and various nano measurements techniques.

**UNIT - I**

**Over View of Nano Technology:** Definition – historical development – properties, design and fabrication Nanosystems, working principle, applications and advantages of nano system. Nanomaterials –ordered oxides – Nano arrays – potential health effects.

**UNIT – II:**

**Nano Defects, Nano Partiles and NanoLayers:** Nanodefects in crystals – applications – Nuclear Track nano defects. Fabrication of nano particles – LASER ablation – sol gels – precipitation of quantum dots. Nano layers – PVD, CVD, Epitaxy and ion implantation – formation of Silicon oxide- chemical composition – doping properties – optical properties.

**UNIT- III:**

**Nano structuring:** Nanophotolithography – introduction – techniques – optical – electron beam – ion beam – X-ray and Synchrotron – nanolithography for microelectronic industry – nanopolishign of Diamond – Etching of Nano structures – Nano imprinting technology – Focused ion beams - LASER interference Lithography nanoarrays –Near-Field Optics - case studies and Trends.

**UNIT- IV:**

**Science and Synthesis of Nano Materials:** Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics –Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes – Solid carbon source-based production techniques – Gaseous carbon source-based production techniques – Diamond like carbon coating. Top down and bottom up processes.

**UNIT –V:**

**Characterization of Nano Materials:** Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy,



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diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

**Text Books:**

1. Tai-Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
2. Fahrner W.R., Nanotechnology and Nanoelectronics, Springer (India) Private Ltd., 2011.
3. Mark Madou, Fundamentals of Microfabrication, CRC Press, New York, 1997.
4. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003.

**Reference Books:**

1. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006, ISBN: 8493-9138-5.
2. Waqar Ahmed and Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, Elsevier Inc., 2013, ISBN: 978-93-82291-39-8 29.
3. Sami Franssila, Introduction to Micro fabrication, John Wiley & sons Ltd, 2004. ISBN: 470-85106-6.
4. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003.
5. Julian W. Hardner Micro Sensors, Principles and Applications, CRC Press 1993.



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**BUSINESS ANALYTICS (Open Elective)**

**Course Objectives:**

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Manage business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

**Course Outcomes:**

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

**UNIT- I**

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages, Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

**UNIT- II**

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

**UNIT- III**

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive



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analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

**UNIT- IV**

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carlo Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

**UNIT- V**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Recent Trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

**Text Books:**

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.



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**INDUSTRIAL SAFETY (Open Elective)**

**Course Objectives:**

1. To provide information regarding different elements of industrial water pollution and Methods of treatment.
2. To expose to the various industrial applications, maintenance, preventive measures taken against wear and tear.

**Course Outcomes:** At the end of the course, student will be able to:

1. Know how to take safety measures in executing works
2. Identify the need for maintenance (or) replacement of equipment
3. Understand the need for periodic and preventive maintenance

**UNIT- I**

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

**UNIT- II**

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

**UNIT- III**

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications,

- i. Screw down grease cup,
- ii. Pressure grease gun,
- iii. Splash lubrication,
- iv. Gravity lubrication,
- v. Wick feed lubrication
- vi. Side feed lubrication,



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vii. Ring lubrication,

Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

**UNIT- IV**

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like,

- i. Any one machine tool,
- ii. Pump
- iii. Air compressor
- iv. Internal combustion engine,
- v. Boiler,
- vi. Electrical motors, Types of faults in machine tools and their general causes.

**UNIT- V**

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of:

- i. Machine tools,
- ii. Pumps,
- iii. Air compressors,
- iv. Diesel generating (DG) sets,

Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance. Repair cycle concept and importance.

**Reference Books:**

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.





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**OPERATIONS RESEARCH (Open Elective)**

**Prerequisite:** Nil

**Course Outcomes:** At the end of the course, the student should be able to

1. Students should be able to apply the dynamic programming to solve problems of discrete and continuous variables.
2. Students should be able to apply the concept of non-linear programming
3. Students should be able to carry out sensitivity analysis
4. Student should be able to model the real-world problem and simulate it.

**UNIT- I**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

**UNIT- II**

Formulation of a LPP - Graphical solution revised simplex method - duality theory – dual simplex method - sensitivity analysis - parametric programming.

**UNIT- III**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem – max flow problem - CPM/PERT.

**UNIT- IV**

Scheduling and sequencing - single server and multiple server models – deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

**UNIT- V**

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

**Text Books:**

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008.
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008.
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009.
5. Pannerselvam, Operations Research: Prentice Hall of India 2010.
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010.



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**COST MANAGEMENT OF ENGINEERING PROJECTS (Open Elective)**

**Prerequisite:** Nil

**UNIT- I**

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

**UNIT- II**

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre-project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

**UNIT- III**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.

**UNIT- IV**

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

**UNIT- V**

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.



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**Text Books:**

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.



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**COMPOSITE MATERIALS (Open Elective)**

**Prerequisite:** Nil

**UNIT- I**

Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

**UNIT – II**

Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

**UNIT – III**

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

**UNIT- IV**

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs –hand layup method – Autoclave method – Filament winding method – Compression moulding –Reaction injection moulding. Properties and applications.

**UNIT – V**

Strength: Lamina Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-critical strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

**Text Books:**

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. W.D. Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.



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4. Composite Materials – K. K. Chawla.
5. Composite Materials Science and Applications – Deborah D. L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi



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**ENERGY FROM WASTE (Open Elective)**

**Prerequisite:** Nil

**UNIT- I**

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

**UNIT- II**

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

**UNIT- III**

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

**UNIT- IV**

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

**UNIT- V**

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

**Text Books:**

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.