IK Gujral Punjab Technical University, Kapurthala

Study Scheme 2018 for M.Tech Embedded Systems

Semester-1

Sem	Course Code	Course Name	L	T	P	Int	Ext	Total	Credits
1	**MTES-101-18**	Programming Languages for Embedded Software	3	0	0	40	60	100	3
1	**MTES-102-18**	Programming with Advanced MC & DSP Processors	3	0	0	40	60	100	3
1	**MTES-PE1X-18**	Program Elective – 1	3	0	0	40	60	100	3
1	**MTES-PE2Y-18**	Program Elective – 2	3	0	0	40	60	100	3
1	**MTES-111-18**	Advance Microcontroller lab	0	0	4	60	40	100	2
1	**MTES-112-18**	Advanced Digital Signal processing lab	0	0	4	60	40	100	2
1	**MTRM-101-18**	Research Methodology & IPR	2	0	0	40	60	100	2
1	**MTAXX-18**	Audit Course I	0	0	0	S/US*	S/US*	100	Non-credit
		Total	**14**	**0**	**8**	**320**	**380**	**800**	**18**

Semester-2

Sem	Course Code	Course Name	L	T	P	Int	Ext	Total	Credits
2	**MTES-103-18**	Internet of Things &Applications	3	0	0	40	60	100	3
2	**MTES-104-18**	System Design with Embedded Linux	3	0	0	40	60	100	3
2	**MTES-PE3X-18**	Program Elective – 3	3	0	0	40	60	100	3
2	**MTES-PE4Y-18**	Program Elective – 4	3	0	0	40	60	100	3
2	**MTES-113-18**	Internet of Things Lab	0	0	4	60	40	100	2
2	**MTES-114-18**	System Design with Embedded Linux Lab	0	0	4	60	40	100	2
2	**MTES-MP1-18**	Mini Project	0	0	4	60	40	100	2
2	**MTAXX-18**	Audit Course II	0	0	0	S/US*	S/US*	100	Non-credit
		Total	**12**	**0**	**12**	**340**	**360**	**800**	**18**

***S/US-Satisfactory/Unsatisfactory**

Semester-3

Sem	Course Code	Course Name	L	T	P	Int	Ext	Total	Credits
3	**MTES-PE5X-18**	Program Elective -5	3	0	0	40	60	100	3
3	**MTOE-301X-18**	Open Elective	3	0	0	40	60	100	3
3	**MTES-DS1-18**	Dissertation Phase-I	0	0	20	60	40	100	10
		Total	**6**	**0**	**20**	**140**	**160**	**300**	**16**

Semester-4

Sem	Course Code	Course Name	L	T	P	Int	Ext	Total	Credits
4	**MTES-DS2-18**	Dissertation Phase-II	**0**	**0**	**32**	**60**	**40**	**100**	**16**
		Total				**860**	**940**	**2000**	**68**

Program Electives

Program Elective I	
MTES-PE1A-18	Advanced Computer Architecture
MTES-PE1B-18	Advanced Digital Signal Processing
MTES-PE1C-18	Embedded System for Wireless & Mobile Communication
Program Elective II	
MTES-PE2A-18	Soft Computing Techniques
MTES-PE2B-18	PLC &Industrial Automation
MTES-PE2C-18	Hardware and Software Co-Design
Program Elective III	
MTES-PE3A-18	Electronic System Design
MTES-PE3B-18	Artificial Intelligence
MTES-PE3C-18	Mechatronic Systems
Program Elective IV	
MTES-PE4A-18	Designing with Power Devices
MTES-PE4B-18	Cloud computing
MTES-PE4C-18	Advanced Sensors and Actuator
Program Elective V	
MTES-PE5A-18	Sensor Technology and MEMS
MTES-PE5B-18	Reliability of Electronics
MTES-PE5C-18	Medical Electronics and instrument

List of Audit courses I & II

MTA101-18 English for Research Paper Writing
MTA102-18 Disaster Management
MTA103-18 Sanskrit for Technical Knowledge
MTA104-18 Value Education
MTA105-18 Constitution of India
MTA106-18 Pedagogy Studies
MTA107-18 Stress Management by Yoga
MTA108-18 Personality Development through Life Enlightenment Skills

IK Gujral Punjab Technical University, Kapurthala

FIRST SEMESTER

M.Tech (EMBEDDED SYSTEMS)

MTES-101-18	Credits	L	T	P	Int	Ext
Programming Languages for Embedded Software	3	3	0	0	40	60

Course Objective: The main objective of the course to train the students for embedded C programming with concept of OOPs with introduction to Scripting Languages.

Course Outcomes

At the end of this course student will demonstrate the ability 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 1: 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 2: Object Oriented Programming

Introduction to procedural, modular, object-oriented and generic programming techniques, Limitations of procedural programming, objects, classes, data members, methods, data encapsulation, data abstraction and information hiding, inheritance, polymorphism

Unit 3: 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 4: 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 5: 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 6: 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

References:

- Michael J. Pont , "Embedded C", Pearson Education, 2nd Edition, 2008
- Randal L. Schwartz, "Learning Perl", O'Reilly Publications, 6th Edition 2011
- A. Michael Berman, "Data structures via C++", Oxford University Press, 2002
- Robert Sedgewick, "Algorithms in C++", Addison Wesley Publishing Company, 1999
- Abraham Silberschatz, Peter B, Greg Gagne, "Operating System Concepts", John Willey & Sons, 2005

MTEP-102-18	Credits	L	T	P	Int	Ext
Microcontrollers and Programmable Digital Signal Processors	3	3	0	0	40	60

Course Objective

To introduce ARM processor which is widely used in embedded system and Digital signal processing has become a part of many embedded systems. This subject provides basic knowledge of ARM microcontrollers and DSP.

Course Outcomes

At the end of this course student will demonstrate the ability 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 1: ARM Cortex-M3 Processor

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 2: Exceptions

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

Unit 3: LPC 17xx Microcontroller

Internal memory, GPIOs, Timers, ADC, UART and other serial interfaces, PWM, RTC, WDT

Unit 4: 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 5: 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

Unit 6: Code Composer

Studio for application development for digital signal processing, On chip peripherals, Processor benchmarking

References:

1. Joseph Yiu, “The definitive guide to ARM Cortex-M3”, Elsevier, 2nd Edition
2. Venkatramani B. and Bhaskar M. “Digital Signal Processors: Architecture, Programming and Applications” , TMH , 2nd Edition
3. Sloss Andrew N, Symes Dominic, Wright Chris, “ARM System Developer's Guide: Designing and Optimizing”, Morgan Kaufman Publication
4. Steve furber, “ARM System-on-Chip Architecture”, Pearson Education
5. Frank Vahid and Tony Givargis, “Embedded System Design”, Wiley
6. Technical references and user manuals on www.arm.com, NXP Semiconductor www.nxp.com and Texas Instruments www.ti.com

MTES-PE1X-18Program Electives-I

MTES-PE1A-18	Credits	L	T	P	Int	Ext
Advanced Computer Architecture	3	3	0	0	40	60

Course Objective

An overview of computer architecture, which stresses the underlying design principles and the impact of these principles on computer performance. General topics include design methodology, processor design, control design, memory organization, system organization, and parallel processing

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand parallelism and pipelining concepts, the design aspects and challenges.
2. Evaluate the issues in vector and array processors.
3. Study and analyze the high performance scalable multithreaded and multiprocessor systems.

Unit 1: Parallel Processing and Pipelining Processing

Architectural Classification, Applications of parallel processing, Instruction level Parallelism and Thread Level Parallelism, Explicitly Parallel Instruction Computing (EPIC) Architecture

Unit 2: Pipeline Architecture

Principles and implementation of Pipelining, Classification of pipelining processors, Design aspect of Arithmetic and Instruction pipelining, Pipelining hazards and resolving techniques, Data buffering

techniques, Advanced pipelining techniques, Software pipelining, VLIW (Very Long Instruction Word) processor.

Unit 3:Vector and Array Processor

Issues in Vector Processing, Vector performance modeling, SIMD Computer Organization, Static Vs Dynamic network, Parallel Algorithms for Array Processors: Matrix Multiplication.

Unit 4: Multiprocessor Architecture

Loosely and Tightly coupled multiprocessors, Inter Processor communication network, Time shared bus, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherency and bus snooping, Massively Parallel Processors (MPP).

Unit 5: Multithreaded Architecture

Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions, Parallel Programming Techniques: Message passing program development.

Unit 6: Parallel algorithms for multiprocessors

Classification and performance of parallel algorithms, operating systems for multiprocessors systems, Message passing libraries for parallel programming interface, PVM (in distributed memory system), Message Passing Interfaces (MPI).

References:

- Kai Hwang, Faye A. Briggs, “Computer Architecture and ParallelProcessing” McGraw Hill Education, 2012.
- Kai Hwang, “Advanced Computer Architecture”, McGraw Hill Education, 1993.
- William Stallings, “Computer Organization and Architecture, Designing for Performance” Prentice Hall, 6th edition, 2006.
- Kai Hwang, “ScalableParallelComputing”, McGraw Hill Education, 1998.
- Harold S. Stone “High-Performance Computer Architecture”, Addison-Wesley, 1993.

MTES-PE1B-18	Credits	L	T	P	Int	Ext
ADVANCED DIGITAL SIGNAL PROCESSING	3	3	0	0	40	60

Course Objective

To provide an understanding of the principles and concepts digital signal processing, to introduce compressive sensing and its application to automatic target recognition, to provide an understanding of current research in advanced digital signal processing.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. To understand theory of different filters and algorithms
2. To understand theory of multi rate 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 1: 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, and Parallel all pass realization of IIR.

Unit 2: Multi rate DSP Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in sub band coding. Unit 3 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 3: Adaptive Filters Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm

Unit 4: 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. Unit6 Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications

References:

- J.G.Proakis and D.G.Manolakis"Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
- N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.
- Bruce W. Suter, "Multirate and Wavelet Signal Processing",1st Edition, Academic Press, 1997.
- M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.
- S.Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.

MTES-PE1C-18	Credits	L	T	P	Int	Ext
EMBEDDED SYSTEM FOR WIRELESS & MOBILE COMMUNICATION	3	3	0	0	40	60

Course Objective To make the student understand and apply the theory behind wireless sensor networks.

Course Outcomes At the end of this course student will demonstrate the ability to

1. Use suitable principles and standards in design and evaluation of sensor networks and wireless communication protocols for small digital transmitters.

2. Demonstrate an ability to read, critically evaluate, analyses and present (verbally or in written form) the content and implications of research articles in the area.
3. Drawing on relevant results from research literature design and implement software and system solutions for wireless embedded systems.

Unit 1: Introduction to wireless technologies

WAP services, Serial and Parallel Communication, Asynchronous and synchronous Communication, FDM, TDM, TFM, Spread spectrum technology.

Unit 2: Introduction to Bluetooth

Specification, Core protocols, Cable replacement protocol Bluetooth Radio: Type of Antenna, Antenna Parameters, Frequency hopping

Unit 3: Bluetooth Networking

Wireless networking, wireless network types, devices roles and states, adhoc network, scatter net Connection establishment procedure, notable aspects of connection establishment, Mode of connection, Bluetooth security, Security architecture, Security level of services, Profile and usage model: Generic access profile (GAP), SDA, Serial port profile, Secondary bluetooth profile.

Unit 4: HardwareBluetooth Implementation, Baseband overview, packet format, Transmission buffers, Protocol Implementation: Link Manager Protocol, Logical Link Control Adaptation Protocol, Host control Interface, Protocol Interaction with layers

Unit 5: Programming with Java

Java Programming, J2ME architecture, Javax. Bluetooth package Interface, classes, exceptions, Javax.

Unit 6: Obex Package

interfaces, classes bluetooth services registration and search application, bluetooth client and server application.Overview of IrDA, HomeRF, Wireless LANs, JINI

BOOKS:

- Bluetooth Technology by C.S.R. Prabhu and A.P. Reddi; PHI
- Rappaport. T.S., “Wireless communications”, Pearson Education, 2003. Mobile communication by Schiller
- Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2006.
- Simon Haykin& Michael Moher, “Modern Wireless Communications”, Pearson Education, 2007.
- Gordon L. Stuber, “Principles of Mobile Communication”, Springer International Ltd., 2001.

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MTES-PE2Y-18 Program Electives-II

MTES-PE2A-18	Credits	L	T	P	Int	Ext
SOFT COMPUTING	3	3	0	0	40	60

Course Objective this course will cover fundamental concepts used in soft computing. The concepts of fuzzy logic(FL) will be covered first, followed by Artificial Neural Networks(ANNS) and optimizing techniques using genetic Algorithm(GA).

Course Outcomes At the end of this course student will demonstrate the ability to:

1. Understand importance of soft computing.
2. Understand different soft computing techniques like Genetic Algorithms, Fuzzy Logic, Neural Networks and their combination.
3. Implement algorithms based on soft computing.
4. Apply soft computing techniques to solve engineering or rea life problems.

Unit 1: Introduction

History of development in neural networks, neural network characteristics, Artificial neural network technology, Model of a neuron, topology, learning, types of learning, supervised, unsupervised and reinforcement learning.

Unit 2: Supervised Learning

Basic hop field model, the perceptron, linear reparability, Basic learning laws, Hebb's rule, Delta rule, Widroff and Huff LMS learning rule, correlation learning rule, In star and out star learning rules. Unsupervised learning, competitive learning, K mean clustering algorithm, Kolwner's feature maps

Unit 3: Radial Basis Function

Basic learning laws in RBF network, recurrent networks, recurrent back propagation, Real time recurrent learning algorithm.

Unit 4: Counter Propagation Networks

Introduction to counter propagation networks, CMAC networks, ART networks, Application of neural networks, pattern recognition, optimization, associative memories, vector quantization, control.

Unit 5: Fuzzy Logic

Basic concepts of fuzzy logic, Fuzzy logic crisp set, Linguistic variable, Membership functions, Operation of fuzzy set, Fuzzy IF-THEN rules, Variable inference techniques, Defuzzification techniques, Basic fuzzy inference algorithm, Application of fuzzy logic, Fuzzy system design, Implementation of fuzzy system, Useful tools supporting design.

Unit 6: Support Vector Machines

Introduction, Support Vector classification, Support Vector regression, applications.

Unit 7: Basics of Genetic Algorithms

Evolution of Genetic and Evolutionary Algorithms, Applications.

BOOKS RECOMMENDED:

- Berkin R and Trubatch, *Fuzzy System Design Principles*, Prentice Hall
- Cristianini N and Taylor JS, *An Introduction to Support Vector Machines (and other Kernel –*
- *based learning methods)*, Cambridge University Press
- Kosko B, *Nueral Networks and Fuzzy Logic*, Prentice Hall
- Haykin S, *Neural Networks*, Pearson Education
- Anderson JA, *An Introduction to Neural Networks*, Prentice Hall
- Sivanandam S and Deepa SN, *Principles of Soft Computing*, Wiley India

MTES-PE2B-18	Credits	L		T	P	Int	Ext
PLC and Industrial Automation	3	3		0	0	40	60

Course Objective: To provide knowledge levels needed for PLC programming and operating, to make the students understand various types of PLC registers and apply PLC Timers and Counters for the control of industrial processes

Course Outcomes At the end of this course student will demonstrate the ability to:

1. Ability to gain knowledge on Programmable Logic Controllers
2. Will understand different types of Devices to which PLC input and output modules are connected
3. To provide the knowledge about understand various types of PLC registers
4. Able to create ladder diagrams from process control descriptions.
5. Ability to apply PLC timers and counters for the control of industrial processes
6. Able to use different types PLC functions, Data Handling Function.

Unit 1: Introduction

Introduction to Programmable Logic Controllers (PLCs), history of PLCs, Characteristics, Operation, function, Types of PLC Advantages of PLCs and Comparison of PLC based control systems with computers.

Unit 2: PLC Hardware

Block diagram of PLC, Internal architecture of PLC, The I/O section, Digital and Analog Input output modules of PLCs, special I/O Modules, I/O specifications, CPU, Memory design and human machine interfaces.

Unit 3: PLC Instructions

Number system and codes, fundamental of logic, Bit Logic Instructions, Instruction set: Bit level instructions, Compare, Move/Logical, Math, Program Control Instructions etc

Unit 4: Basics of PLC programming-Ladder

Diagram of logic gates, program files, program scan, PLC programming languages, branch instructions.

Unit 5: PLC Timers and Counter Instruction

Various types of PLC timers with detailed timing diagrams: On delay timer, Off delay timer, Retentive on delay timer, Pulse timer. Various types of PLC counters: Up counter, Down counter, Up-Down counter, Programming of various applications using timers and counters using Ladder diagram only.

Unit 6: PLC communications

Parallel and Serial, communication interface, Simplex, Half duplex, Full duplex, RS 232- DB-25 connector, DB-9 connector, RS 422, EIA 485 interface, Introduction of industrial network, Bus topology, Ring topology, Star topology, Tree topology.

Unit 7: Industrial Automation

Basic Concept, History and Hierarchy of Functions of each level, Advantages and Disadvantages. Architecture of SCADA, Working of SCADA, PLC, DCS and SCADA suitability, Applications: Thermal power plant, Irrigation and Cement factory.

Books Recommended:

- Programmable Logic Controllers by Frank D. Petruzella, McGraw-Hill Education; 4 edition (1 October 2010)
- Programmable Logic Controllers: Principles and Applications, 5Th Edition by Webb/Reis, Pearson India, 2015
- Programmable Logic Controllers by john W. Webb: Principles and Applications (Fifth Edition)

MTES-PE2C-18	Credits	L	T	P	Int	Ext
HARDWARE AND SOFTWARE CO-DESIGN	3	3	0	0	40	60

Course Objective:

This course provides an introduction to the design of electronic systems that incorporate both hardware and software components. Techniques for modeling hardware and software components at different levels of abstraction and at their interfaces are investigated

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. To provide a strong theoretical background and practical experience in the design and development of sophisticated embedded systems of moderate complexity through the use of contemporary tools and formal design methodologies.
2. To understand the importance of safety and reliability in contemporary embedded systems.
3. To investigate and apply techniques for performance optimization.
4. To introduce the growing area of distributed embedded systems.

Unit 1: 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 2: 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 3: 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 4: Design Specification and Verification

Design, co-design, the co-design computational model, concurrency coordinating concurrent computations, interfacing components, design verification, implementation verification, verification tools and interface verification

Unit 5: 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 cosyma system and lycos system.

Books Recommended:

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

MTES-111-18	Credits	L	T	P	Int	Ext
Advance Microcontroller lab	2	0	0	4	60	40

Course Objective: To demonstrate programming proficiency using the various addressing modes and data transfer instructions of the ARM microcontroller and to interface the controller to external devices

Course Outcomes

At the end of this course student will demonstrate the ability 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:

Experiments to be carried out on Cortex-M3 development boards and using GNU toolchain

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.

MTES-112-18	Credits	L	T	P	Int	Ext
Advanced Digital Signal Processing lab	2	0	0	4	60	40

Course Objective: To demonstrate programming proficiency for the filter design for both time and frequency domains .

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Design different digital filters in software
2. Apply various transforms in time and frequency

3. Perform decimation and interpolation

List of Assignments:

1. Basic Signal Representation
2. Correlation Auto and Cross
3. Stability Using Hurwitz Routh Criteria
4. Sampling FFT Of Input Sequence
5. Butterworth Lowpass and high pass Filter Design
6. Chebychev Type I, II Filter
7. State Space Matrix from Differential Equation
8. Normal Equation Using Levinson Durbin
9. Decimation and Interpolation Using Rationale Factors
10. Maximally Decimated Analysis DFT Filter
11. Cascade Digital IIR Filter Realization
12. Convolution and M Fold Decimation &PSD Estimator
13. Estimation Of PSD
14. Inverse Z Transform

MTRM-101-18	Credits	L	T	P	Internal	External
RESEARCH METHODOLOGY & IPR	2	2	0	0	40	60

Course Objective

To enable student to acquire knowledge of research process: gather data, implement the proposed work and collect the results and publish them.

Course Outcomes

After the completion of the course, students will be able to

1. Understand research, research process, define and redefine research problem through literature survey.
2. Know the primary and secondary sources of data collection and select sample size based on the requirement.
3. Utilize the resources efficiently.
4. Critically analyse the data through various statistical measures, perform experiment, gather data and reach to a conclusion based on some hypothesis.
5. Know the intellectual property rights.
6. Write up the report and research article.

Unit I Overview of Research: Meaning of Research, Objectives of research, Types of research, Research approaches, Significance of research, Criteria of good research. Defining the research problem: research problem, Necessity of defining the problem, Technique involve in defining a problem.

Unit II Research Design: Need for research design, Features of a good design, Basic principles of Experimental design Data Collection: Methods of Data Collection; Primary data and Secondary Data.

Unit III Data preparation: Data preparation process, designing questionnaires and schedules. Descriptive statistics: Measures of central tendency, Mean,Median, Mode etc. Sampling and

non-sampling errors, Testing of Hypotheses: Parametric (t, z and F) Chi Square, ANOVA, and non-parametric tests.

Unit IV Overview of Intellectual Property: Introduction and the need for intellectual property right (IPR), Patents, Patent Law, Copyright, Trademarks, Geographical Indications, Industrial Design, Unfair Competition, Protection of IPR, Basic steps to write a research paper/ report writing, Introduction to Latex report writing, Introduction to Plagiarism.

Suggested Readings/ Books:

- Krishnaswami K. N., Sivakumar A. I., Mathirajan M., *Management Research Methodology*, Pearson Education, New Delhi
- Kothari C. R., Research Methodology Methods and Techniques, 2nd Edition, New Age International Publishers
- Halbert, Resisting Intellectual Property, Taylor & Francis Ltd ,2007.
- Niebel, Product Design, McGraw Hill.
- Asimov, Introduction to Design, Prentice Hall.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, Intellectual Property in New Technological Age.
- T. Ramappa, Intellectual Property Rights Under WT, S. Chand
- J.F.Kaiser, "Richard Hamming-You and Your Research", Transcription of Bell Communications Research Colloquium Seminar, 1986.

SECOND SEMESTER

M.Tech (EMBEDDED SYSTEMS)

MTES-103-18	Credits	L	T	P	Int	Ext
Internet of Things & Applications	3	3	0	0	40	60

Course Objective: Students will understand the concepts of Internet of Things and can able to build IoT applications.

Course Outcomes At the end of this course student will demonstrate the ability 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 1: 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 2: M2M to IoT -

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

Unit 3:Implementation of IoT-

Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino,introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi, Introduction to SDN, SDN for IoT, Data Handling and Analytics,Cloud Computing.

Unit 4:IoT Applications-

cloud computing, sensor-cloud, Frogcomputing, smart cities and smart homes, connected vehicles, smartGrid, industrial IoT, case study:agriculture, healthcare activity Monitoring.

Unit 5: Internet of Things Privacy, Security and Governance

Introduction, Overview of Governance, Privacy and Security Issues.

Unit 6:Contribution from FP7 Projects

Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.

References:

- Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
- Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1stEdition, Apress Publications, 2013.
- CunoPfister, “Getting Started with the Internet of Things”, OReilly Media, 2011.

MTES-104-18	Credits	L	T	P	Int	Ext
System Design with Embedded Linux	3	3	0	0	40	60

Course Objective: The objective of the course is to provide understanding of the techniques essential to the design and implementation of embedded systems with embedded operating systems

Course Outcomes At the end of this course student will demonstrate the ability 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 1: Embedded Linux Vs Desktop Linux, Embedded Linux Distributions

Unit 2: Embedded Linux Architecture Kernel Architecture _HAL, Memory manager, Scheduler, File System, I/O and Networking subsystem, IPC, User space, Start-up sequence

Unit 3: Board Support Package Embedded Storage, MTD, Architecture, Drivers, Embedded File System Embedded Drivers: Serial, Ethernet, I2 C, USB, Timer, Kernel Modules.

Unit 4: Porting Applications Real-Time Linux: Linux and Real time, Programming, Hard Real-time Linux

Unit 5: Building and Debugging: Kernel, Root file system Embedded Graphics

Unit 6: Case study of uClinux

References:

Karim Yaghmour, “Building Embededd Linux Systems”, O'Reilly & Associates

P Raghvan, Amol Lad, SriramNeelakandan, “Embedded Linux System Design and Development”, Auerbach Publications

Christopher Hallinan, “Embedded Linux Primer: A Practical Real-World Approach”, Prentice Hall, 2nd Edition, 2010.

Derek Molloy, “Exploring BeagleBone: Tools and Techniques for Building with Embedded Linux”, Wiley, 1st Edition, 2014.

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MTES-PE3X-18 Programme Electives-III

MTES-PE3A-18	Credits	L	T	P	Int	Ext
Electronic System Design with HDL	3	3	0	0	40	60

Course Objective

The objective of this course is to provide students with opportunities to learn different types of digital systems and to understand and deal with various practical issues related to their design

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. This is an advanced course on digital design techniques.
2. The students will be able to appreciate the advantages/disadvantages between the implementations using standard logic (SSI, MSI) and programmable logic (PLDs, PGAs).
3. A great deal of emphasis will be given to Hardware Description language- VHDL and its design styles so that students can describe digital systems using HDL.

Unit 1: Introduction to Digital Design Concepts MReview of digital design fundamentals, minimization and design of combinational circuits, sequential machine fundamentals

Unit 2: VHDL Why VHDL? Basic Language Elements, Data objects, classes and data types, operators, overloading, logical operators, VHDL representation of Digital design entity and architectural declarations, introduction to behavioural, dataflow and structural models

Unit 3: Clocked Sequential Finite State Machines State diagram, analysis of synchronous circuits, derivation of state graphs and tables, reduction of state tables, state assignment, design of sequence detectors, serial data code conversion, design of synchronous sequential state machine, design and applications of counters and shift registers

Unit 4: Multi-input System Controllers Design System controller, controller design principles, timing and frequency considerations, DFD development, controller architecture design, asynchronous input handling, state assignment concepts, flip-flop level implementation using VEM's

Unit 5: Sequential Design using LSI & MSI circuits Using decoders, multiplexers in sequential circuits, sequential network design using ROMs, PLAs and PALs, Programmable gate Arrays (PGAs)

Unit 6: Asynchronous Sequential Finite State Machines Introduction, analysis of asynchronous networks, races and cycles, derivation of primitive flow tables, reduction of primitive flow tables, state assignments, hazards, asynchronous sequential network design.

Recommended Books

1. William I Fletcher “An Engineering Approach to Digital Design”, PHI, 3rd Indian reprint, (1994)
2. M Morris Mano “Digital Design”, Pearson Education, 3rd Edition (2002)
3. Z Navabi “VHDL-Analysis and Modelling of Digital Systems”, McGraw Hill, 2nd Edition (1997)
4. Kevin Skahill “VHDL for Programmable Logic”, Pearson Education, 1st Indian Reprint (2004)

MTES-PE3B-18	Credits	L	T	P	Int	Ext
Artificial Intelligence	3	3	0	0	40	60

Course Objective: This course provides an introduction to the fundamentals of artificial intelligence. It contains a theory component about the concepts and principles that underlie modern AI algorithms.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand the concept of Artificial Intelligence, search techniques and knowledge representation issues
2. Understanding reasoning and fuzzy logic for artificial intelligence
3. Understanding game playing and natural language processing.

Unit 1: What is AI (Artificial Intelligence)? : The AI Problems, The Underlying Assumption, What are AI Techniques, The Level Of The Model, Criteria For Success, Some General References, One Final WordProblems, State Space Search & Heuristic Search Techniques: Defining The Problems As A State Space Search, Production Systems, Production Characteristics, Production System Characteristics, And Issues In The Design Of Search Programs, Additional Problems. GenerateAnd-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, MeansEnds Analysis.

Unit 2: Knowledge Representation Issues: Representations And Mappings, Approaches To Knowledge Representation. Using Predicate Logic: Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution. Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning.

Unit 3: Symbolic Reasoning Under Uncertainty: Introduction To No monotonic Reasoning, Logics For Non-monotonic Reasoning. Statistical Reasoning: Probability And Bays' Theorem, Certainty Model Curriculum of Engineering & Technology PG Courses [Volume -II] 289 Factors And Rule-Base Systems, Bayesian Networks, DempsterShafer Theory .

Unit 4 : Fuzzy Logic. Weak Slot-and-Filler Structures: Semantic Nets, Frames. Strong Slot-and-Filler Structures: Conceptual Dependency, Scripts, CYC.

Unit 5: Game Playing: Overview, And Example Domain: Overview, MiniMax, Alpha-Beta Cut-off, Refinements, Iterative deepening, The Blocks World, Components Of A Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques. Understanding: What is understanding? What makes it hard? As constraint satisfaction .

Unit 6 : Natural Language Processing: Introduction, Syntactic Processing, Semantic Analysis, Semantic Analysis, Discourse And Pragmatic Processing, Spell Checking Connectionist Models: Introduction: Hopfield Network, Learning In Neural Network, Application Of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI.

References:

1. Elaine Rich and Kevin Knight "Artificial Intelligence", 2nd Edition, Tata Mcgraw-Hill, 2005.
2. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall, 2009.

MTES-PE3C-18	Credits	L	T	P	Int	Ext
MECHATRONIC SYSTEMS	3	3	0	0	40	60

Course Objective:

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Demonstrate technical competence in the field of mechatronics engineering including problem identification and formulation, as well as dynamic and control analysis of mechatronic systems.
2. Demonstrate the practical skills associated with the use of modern modelling and simulation tools.
3. Design electronic and embedded systems for mechatronic applications including robotic, computer vision and control systems.

Unit 1: Introduction

Definition of Mechatronics, Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach.

Unit2: Review of fundamentals of electronics

Data conversion devices, sensors, microsensors, transducers, signal processing devices, relays, contactors and timers. Microprocessors controllers and PLCs.

Unit 3: Drives

Stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, transfer systems.

Unit 4: Hydraulic systems

Flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, pumps. Design of hydraulic circuits. Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems. Description.

Unit 5 : Controllers

Description of PID controllers, CNC machines and part programming. Industrial Robotics

BOOKS:

1. HMT ltd. Mechatronics, Tata Mcgraw-Hill, New Delhi, 1988.
2. G.W. Kurtz, J.K. Schueller, P.W. Claar . II, Machine design for mobile and industrial applications, SAE, 1994.
3. T.O. Boucher, Computer automation in manufacturing - an Introduction, Chappman and Hall, 1996.
4. R. Iserman, Mechatronic Systems: Fundamentals, Springer, 1st Edition, 2005
5. Musa Jouaneh, Fundamentals of Mechatronics, 1st Edition, Cengage Learning, 2012

MTES-PE4Y-18 Programme Electives-IV

MTES-PE4A-18	Credits	L	T	P	Int	Ext
CLOUD COMPUTING	3	3	0	0	40	60

Course Objective: To learn how to use Cloud Services,to implement Virtualization,to implement Task Scheduling algorithms, Apply Map-Reduce concept to applications, To build Private Cloud, Broadly educate to know the impact of engineering on legal and societal issues involved

Course Outcomes At the end of this course student will demonstrate the ability to:

1. **Analyze the Cloud computing setup with its vulnerabilities and applications using different architectures.**
2. **Design different workflows according to requirements and apply map reduce programming model.**
3. **Apply and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms.**

Unit 1: Introduction to Cloud Computing-Online

Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing

Unit 2: Cloud Computing Architecture -

Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, Traditional Software Model, Cloud Services Delivery Model Cloud Deployment Models: Key Drivers to Adopting the Cloud, The Impact of Cloud

Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise

Unit 3: Security Issues in Cloud Computing-Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its SecurityIdentity and Access Management**:** Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management

Unit 4: Security Management in the Cloud-Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS Privacy Issues**:**
Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations

Unit 5: Audit and Compliance-nternal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud

Unit 6: Advanced Topics-Recent developments in hybrid cloud and cloud security.

BOOKS RECOMMENDED:

1. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Publication 2009
2. Cloud Security and Privacy: An Enterprise perspective on Risks and Compliance (Theory in Practice),2009

MTES-PE4B-18	Credits	L	T	P	Int	Ext
DESIGNING WITH POWER DEVICES	3	3	0	0	40	60

Course Objective: acquire an understanding of the nature of power semiconductor devices and their control and use in switch-mode; understand the arrangement and topology of the circuits in which switch-mode devices.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand basic operation of various power semiconductor devices and switching circuits.
2. Analysis and design Transformers for PWM converters
3. Study principle and operation switch mode power supplies.
4. Study and analyze ups and other power supplies

Unit 1: POWER SEMICONDUCTOR DEVICES

General characteristics of Power devices such as GTOs, Power BJT, Power MOSFET, IGBT, MCT.

Unit 2: TRANSFORMER DESIGN

Fundamentals, Selection of core material, Insulating material and wires, Design Methodology of pulse transformers, High Frequency transformers, Design of Transformers for PWM converters.

Unit 3: COILS

Fundamentals, Selection of core material, Insulating materials and wires, Design of inductors for power frequency, Radio frequency & High frequency.

Unit 4: SWITCH MODE POWER SUPPLIES

Basic regulators, Buck, Boost, Buck Boost, Derived topologies, flyback, forward, Push-pull, half & full bridge converter, Special converters like Cuk‟ converter, PWM control techniques, Study of PWM control ICs Design of base derive circuits, Design of input section, output section & control section, Thermal design concepts, EMI/EMC considerations, Protection circuit design for power supplies.

Unit 5: UPS AND OTHER POWER SUPPLIES

Concept of Uninterrupted power supplies, Inverter preferred (online UPS), Line preferred UPS system (offline UPS system), Line interactive UPS system, Reliability of UPS system, Solar cells as power source devices & their characteristics.

BOOKS RECOMMENDED:

1 George Chryssis, *High frequency switching power supplies: theory & design*, McGraw Hill Book Co. 1984 (Text)

2 K.Kitsum, *Switch mode power conversion –basic theory and design*, Marcel Deckker Inc 1984.

3 N.Radhakrishnan and S.R.Bhat, *Design and technology of low power transformers and inductors*, CEDT, July 1998.

MTES-PE4C-18	Credits	L	T	P	Int	Ext
ADVANCE SENSORS AND ACTUATOR	*3*	*3*	*0*	*0*	*40*	*60*

Course Objective: students are introduced to advanced concepts in sensing and actuation for mechatronic systems, including both traditional sensors and actuators, an introduction to advanced topics in microelectromechanical system (MEMS) sensing, and smart material

Course Outcomes At the end of this course student will demonstrate the ability to:

1. Understand the underlying physical principles of the basic transduction mechanisms of different sensors and actuators.
2. Understand the evolution of emerging sensor and actuator technologies such as micro electromechanical systems (MEMS).
3. Understand the fundamental principles of data acquisition.
4. Demonstrate the ability to apply self-directed learning skills by researching a sensor or actuator not discussed in class.

Unit 1: MEASUREMENT TERMINOLOGY

Input and output, range, accuracy, precision, resolution, sensitivity, linearity, repeatability, reproducibility, calibration and traceability, Testing, quality assurance and safety.

Unit 2: TRANSDUCERS AND SENSORS

Sensors and transducers: Temperature sensors, resistive sensors, capacitive sensors, electrostatic sensors, piezoelectric sensors, ultrasonic sensors, radiological sensors and MEMS. Optical sensing techniques: Common electromagnetic sensors, IR sensors, passive IR sensors, photo-resistive sensors, photovoltaic sensors, photodiodes, photoelectric detectors, solid state lasers, CCD and CMOS sensors.

Unit 3: SMART SENSORS

Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, The Automation Sensors Applications: On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing, Sensors for environmental Monitoring.

Unit 4: ACTUATORS

Pneumatic and Hydraulic Actuation Systems, Actuation systems, Pneumatic and hydraulic systems, Directional Control valves, Pressure control valves, Cylinders, Servo and proportional control valves, Process control valves, Rotary actuators Mechanical Actuation Systems. Electrical Actuation Systems, Electrical systems, Solid-state switches Solenoids, D.C. Motors, A.C. motors, Stepper motors.

Unit 5: EMERGING TOPICS

Introduction to sensor networks, sensor fusion, soft and intelligent sensors. System on module, Virtual instrumentation, Intelligent instrumentation, Fault tolerance, Real time systems introduction, reference model, scheduling approaches.

BOOKS:

1. Patranabis – “Sensors and Transducers” –PHI Learning Private Limited.
2. W. Bolton – “Mechatronics” –Pearson Education Limited.
3. Sensors and Actuators – D. Patranabis – 2nd Ed., PHI, 2013.
4. Micro sensors, MEMS and Smart devices Julian W. Gardner ,Vijay K. Varadan John Wiley & Sons.
5. Smart Sensor Systems Edited by Gerard C.M. Meijer © 2008 John Wiley & Sons, Ltd.
6. Ristic L (ed), “Sensor Technology and Devices”, Artech House, London, 1994.
7. Sze S.M. (ed), “Semiconductor Sensors”, John Wiley, New York, 1994 Wise
8. K.D. (Guest Editor) “Integrated Sensors, Microp-actuators and micro-systems
9. MEMS, Special Issue of proceedings of IEEE, Vol. 86, No.8, August 1998

MTES-113-18	Credits	L	T	P	Int	Ext
Internet of Things and Applications LAB	2	0	0	4	60	40

Course Objective This is laboratory course meant to to explore different aspects and develop different applications in IoT field.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand the concept of embedded programming and RF Experiments.
2. Study the Experiments on interfacing with raspberry pi/Arduino board/Ubisense
3. To Study the WSN and IOT Applications.

Experiments

Embedded Programming

Toggling LEDs, transmitting a string through UART, Controlling LEDs blinking pattern through UART, Echo each character typed on serial terminal, Digital IO configuration, Timer based LED Toggle, On-chip Temperature measurement through AD.

RF experiments

Point-to-Point communication of two Motes over the radio frequency, Multi-point to single point communication of Motes over the radio frequency.

Experiments on interfacing with raspberry pi/Arduino board/Ubisense

I2C protocol study, Reading Temperature and Relative Humidity value from the sensor, Reading Light intensity value from light sensor, reading of atmospheric pressure value from pressure sensor, Proximity detection with IR LED, Generation of alarm through Buzzer, Transmitting the measured physical value over the Air.

WSN Applications

Demonstration of a Peer-to-Peer network topology using Coordinator and end device network device types, Demonstration of Peer-to-Peer communication between Coordinator and end device through Router, Establishing Many-to-One Communication (Star Network Topology), Establishing Tree Network Topology, Establishing Cluster Tree Network.

IOT applications

Porting 6LoWPAN stack on mote for enabling it with IPv6, 6LoWPAN network formation with motes and PC, IP based lighting control through Data Acquisition Card, IP based sensor monitoring.

Students are required to do one case study from the following:

Smart Cities and Smart Homes, Connected Vehicles: Smart Grid: Industrial IoT ,Agriculture, Healthcare, Activity Monitoring

MTES-114-18	Credits	L	T	P	Int	Ext
System Design with Embedded Linux LAB	2	0	0	4	60	40

Course Objective

This is laboratory course meant to realize the system design with embedded Linux for real time applications

Course Outcomes At the end of this course student will demonstrate the ability 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

Experiments

1. Create processes using different system calls like fork, exec, wait etc.
2. Develop program for a Orphan and Zombie process.
3. Develop programs to create threads, passing data to threads, joining threads and using thread attributes.
4. Develop programs to interface system call.
5. Develop programs to use different IPC‟s- Pipes, Message Queues, FIFO and Sockets
6. Develop programs to use different synchronization techniques – Semaphore, Shared Memory, Mutex.
7. Write Device Driver modules that registers a character device with major no and with File Operations -Open, Release, Read, Write etc.
8. Develop programs to implement Realtime FIFO.
9. Using socket program develop a simple file transfer programs.
10. Write programs to determine CPU usage in a multitasking environment in µCOS-II.
11. Develop programs to demonstrate stack- checking feature of µCOS-II

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THIRD SEMESTER

M.Tech (EMBEDDED SYSTEMS)

IK Gujral Punjab Technical University, Kapurthala

MTES-PE5X-18 Programme Electives-V

MTES-PE5A-18	Credits	L	T	P	Int	Ext
Reliability of Electronics & Communication Systems	3	3	0	0	40	60

Course Objective: Students are introduced toConcept of reliability, Reliability Data and Analysis Data, System Reliability and Modeling, Maintainability and Availability.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Demonstrate understanding of basic reliability measures such as failure rate, availability, MTTR, etc.
2. Compute and evaluate reliability for redundant, series, and parallel systems
3. Develop fault trees and apply various reliability models to identify and analysis possible faults in machine systems and assess their impact on overall system reliability & maintainability.
4. Use reliability improvement techniques and undertake product testing.

Unit 1: Concept of reliability Failures of systems and its modes. Measure of Reliability, Reliability function, Hazard rate MTBF and their interrelations.

Unit 2: Reliability Data and Analysis Data sources, Data collection, use of Reliability Data, Reliability Analysis, Performance Parameters, calculation of failure rate, Application of Weibill distribution.

Unit 3: System Reliability and Modeling Series systems, Parallel system, series parallel systems. Time dependence, Reliability Determination, stand by systems, r out of n, Configurations, Methods of tie set and cut sets of or reliability evaluation, simulation and Reliability prediction. Monte Carlo method, concepts of network topology. Overall reliability evolution.

Unit 4: Maintainability and Availability Maintainability and its equation. Factors Affecting maintainability. Measures of Maintainability, Mean Down Time, Availability Intrinsic availability equipment availability & Mission availability. Replacement processes and Policies.

Unit 5: Life Testing of Equipment's-Non-destructive tests, destruction tests and their Mathematic modeling. Quality and Reliability, Measurement & prediction of Human Reliability, Reliability and safety, safety margins in critical Devices, case studies. 6. Value Engineering Techniques in value Engg; Structure of value Engg. Reliability Management.

Unit 6: Value Engineering Techniques in value Engg; Structure of value Engg. Reliability Management.

Books Recommended:

1. Reliability Engg. By Govil, 1992.
2. Reliability Engg. By Dr.A.K.Aggarwal, 1992.
3. Related IEEE/IEE publications

MTES-PE5B-18	Credits	L	T	P	Int	Ext
SENSOR TECHNOLOGY AND MEMS	3	3	0	0	40	60

Course Objective: The objective of this course is to make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques. This enables them to design, analysis, fabrication and testing the MEMS based components. And to introduce the student's various opportunities in the emerging field of MEMS

Course Outcomes At the end of this course student will demonstrate the ability to:

1. Design fabrication process plan for development of MEMS
2. Identify characterization and assembly techniques for developed MEMS.
3. Develop physics-based model of MEMS

Unit 1: Introduction

Historical Development of Microelectronics, Evolution of Micro sensors, Evolution of MEMS, Emergence of Micro machines, Sensor Systems, Sensors types and classification, Mechanical Sensors, Acoustic Sensors, Magnetic Sensors, Thermal Sensors, Optical sensors Chemical Sensors, Radiation Sensors and Biosensors. Micro sensors, Sensors based on surface-acoustic wave devices. Review of Fabrication Techniques (Lithography, PVD, CVD, RIE) .

Unit 2: Micromachining techniques

Introduction to Bulk Micromachining, Isotropic and Orientation-Dependent Wet Etching, Dry Etching, Buried Oxide Process, Silicon Fusion Bonding, Sacrificial Layer Technology, Surface Micromachining using Plasma Etching, Combined 1C Technology and Anisotropic Wet Etching, Processes Using Both Bulk and Surface Micromachining, Adhesion Problems in Surface Micromachining, Surface Versus Bulk Micromachining.

Unit 3: MICROSYSTEMS DESIGN AND PACKAGING

Design considerations, Mechanical Design, Process design, Realization of MEMS components. Micro system packaging, Packing Technologies, Assembly of Microsystems, Reliability in MEMS. Micro system packaging materials - die level - device level - system level - packaging techniques – die preparation – surface bonding - wire bonding - sealing

Unit 4: Smart Sensors and Modeling.

Introduction to Smart Sensors, Integrated Smart sensors and smart systems, MEMS and NEMS devices, Elastic structures in MEMS and NEMS, Modeling of Thermal Elastic systems, Electrostatic-elastic systems, magnetically actuated systems, Microfluidics (Membrane Pumps, Nanolithography, Nano jets)

BOOKS:

1. Modeling MEMS and NEMS John A. Pelesko and David H. Bernstein Chapman & Hall/CRC
2. MEMS Fundamental Technology and Applications vikas Choudhary and Krzysztof Iniewski CRC press
3. Micro sensors, MEMS and Smart devices Julian W. Gardner, Vijay K. Varadan John Wiley & Sons, Ltd
4. Smart Sensor Systems Edited by Gerard C.M. Meijer © 2008 John Wiley & Sons, Ltd.
5. Ristic L (ed), "Sensor Technology and Devices", Artech House, London, 1994.
6. Sze S.M. (ed), "Semiconductor Sensors", John Wiley, New York, 1994 Wise
7. K.D. (Guest Editor) "Integrated Sensors, Microp-actuators and micro-systems
8. MEMS, Special Issue of proceedings of IEEE, Vol. 86, No.8, August 1998.
9. MEMS and Microsystems Design and Manufacture" by Tai-Ran Hsu. Tata McGraw-Hill Publishing Company Ltd

MTES-PE5C-18	Credits	L	T	P	Int	Ext
Medical Electronics and Instrument	3	3	0	0	40	60

Course Objective: The objective of this course is to introduce student to basic biomedical engineering technology and introduce different biological signals, their acquisition, measurements and related constraints.

Course Outcomes At the end of this course student will demonstrate the ability to:

1. Define basic medical terms and physical values that can be handled by medical instrumentation.
2. Describe methods and implementation of electrical and nonelectrical medical parameters diagnostic
3. Demonstrate measuring of basic medical parameters calculate basic parameters of the equipment for using in electro diagnostic and electro therapy.
4. Recommend problem solving and service procedures for electrical equipment.
5. Apply safety standards and select disposal method and procedures for electrical diagnostic equipment.

Unit 1: Human Body Subsystems

Brief description of neuronal, muscular, cardiovascular and respiratory systems; their electrical, mechanical and chemical activities.

Unit 2: Cardiovascular System

Measurement of blood pressure, blood flow, cardiac output, cardiac rate, heart sounds; Electrocardiograph, Phonocardiograph, Plethysmograph.

Unit 3: Respiratory System

Measurement of gas volume, flow rate, carbon-dioxide and oxygen concentration in exhaled air.

Unit 4: Electrical Activity in Neuromuscular System and Brain

Neuron potential, muscle potential, electromyography, brain potentials, electroencephalograph.

Unit 5: Medical Imaging

Fundamentals of imaging, Computed tomography, MRI, Nuclear Medicine, Single photon emission computed tomography, PET, Ultrasonography, Electrical Impedance, Tomography.

Unit 6: Medical Safety

Electrical Safety, Electrical safety codes and standards; Radiation safety, Chemical safety, Biological safety, Fire and explosive safety, Environmental Safety.

Unit 7: Assisting and Therapeutic Equipment's

Pacemakers, Defibrillators, Ventilators, Nerve and Muscle stimulators, Diathermy, Heart-Lung machine, Infant incubators, Audio meters, Dialyzers.

Books Recommended:

- Webster JG (Ed.), *Medical Instrumentation, Application and Design*, Wiley India
- Carr JJ and Brown JM, *Introduction to Biomedical Equipment Technology*, Pearson Education
- Waugh A and Grant A, *Ross and Wilson Anatomy and Physiology in Health and Illness*, Elsevier
- Webster JG (Ed.), *Encyclopedia of Medical Devices and Instrumentation*, Vols. 1-4, Wiley
- Bronzino JD (Ed.), *The Biomedical Engineering Handbook*, CRC Press

MTOE-301X-18 Open Electives

MTOE-301A-18	Credits	L	T	P	Int	Ext
Open Elective Cost Management of Engineering Projects	3	3	0	0	40	60

Course Objective

This is course deals with strategic cost management for engineering projects and useful quantitative techniques to implement

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand the cost calculation for decision-making about an engineering research project
2. Able to define Role of each member in the project team
3. Manage the project by applying Quantitative techniques for cost management

Unit 1

Introduction and Overview of the Strategic Cost Management Process

Unit 2:

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 3:

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.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. 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 4:

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

Recommended 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.

MTOE-301B-18	Credits	L	T	P	Int	Ext
Open Elective Composite Materials	3	3	0	0	40	60

Course Objective

This is course deals with Composite Materials and preparation/manufacturing of Metal Matrix Composites

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand the characteristics of Composite materials and their advantages and applications
2. Get exposure to Manufacturing of Metal Matrix Composites: Knitting, Braiding, Weaving and estimate Strength

Unit 1

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 2:

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 Isostressconditions.

Unit 3:

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 4:

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 5:

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

Recommended Books :

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

MTOE-301C-18	Credits	L	T	P	Int	Ext
Open Elective Waste to Energy	3	3	0	0	40	60

Course Objective

This is course deals with effective and cheap methods to convert waste into useful energy.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand various methods to convert agro, forest and industrial residue to useful energy
2. Get exposure Biomass Combustion, Biomass Gasification etc.

Unit 1

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

Unit 2:

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

Unit 3:

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 kineticconsideration in gasifier operation.

Unit 4:

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 5:

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.

Recommended 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
3. Publishing Co. Ltd., 1983.
4. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
5. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

IK Gujral Punjab Technical University, Kapurthala

MTAXX-18 Audit Courses

MTA1O1-18	Credits	L	T	P	Int	Ext
English for research paper writing	Non-credit	2	0	0	S/US	S/US

Course Objective

This course is to develop skills in effective English writing to communicate the research work

Course Outcomes

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

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

Unit 1

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

Unit 2

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

Unit 3

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

Unit 4

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 5

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

Unit 6

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Recommended Books :

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.

MTA102-18	Credits	L	T	P	Int	Ext
Disaster Management	Non-credit	2	0	0	S/US	S/US

Course Objective

This course is to develop skills in helping society during natural disasters and how to manage.

Course Outcomes

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

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. 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 1

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

Unit 2

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 3

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 4

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 5

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 6

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.

Recommended Books :

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" New Royal book Company.
2. Sahni, PardeepEt.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.

MTA103-18	Credits	L	T	P	Int	Ext
Sanskrit For Technical Knowledge	Non-credit	2	0	0	S/US	S/US

Course Objective

This course is to develop

1. A working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course Outcomes

At the end of this course students will be able to

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

Unit 1

Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Unit 2

Order, Introduction of roots, Technical information about Sanskrit Literature.

Unit 3

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

Recommended Books :

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi

2. “Teach Yourself Sanskrit” Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi.

MTA104-18	Credits	L	T	P	Int	Ext
Value Education	Non-credit	2	0	0	S/US	S/US

Course Objective

This course is to develop

1. Value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Course Outcomes

At the end of this course students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

Unit 1

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 2

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 3

Personality and Behavior Development - Soul and Scientific attitude, Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness, 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 4

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.

Recommended Books :

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

MTA105-18	Credits	L	T	P	Int	Ext
Constitution of India	Non-credit	2	0	0	S/US	S/US

Course Objective

This course is to

1. Understand the premises informing the twin themes of liberty and freedom from a civilrights perspective.
2. 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.
3. 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:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. 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.
4. Discuss the passage of the Hindu Code Bill of 1956.

Unit 1:

History of Making of the Indian Constitution:History, Drafting Committee, (Composition & Working).

Unit 2:

Philosophy of the Indian Constitution:Preamble, Salient Features.

Unit 3:

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 PolicyFundamental Duties.

Unit 4:

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

Unit 5:

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: ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials,Importance of grass root democracy.

Unit 6:

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.

Recommended Books :

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.

MTA106-18	Credits	L	T	P	Int	Ext
Pedagogy Studies	Non-credit	2	0	0	S/US	S/US

Course Objective

This course is to inculcate better teaching methods/tools for future teachers to build a better education system to compete with the developed nations pedagogical practices

Course Outcomes

Students will be able to understand:

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

Unit 1:

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 2:

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

Unit 3:

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth 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 foreffective pedagogical practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.

Unit 4:

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 5:

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

Recommended Books :

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 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

MTA107-18	Credits	L	T	P	Int	Ext
Stress Management By Yoga	Non-credit	2	0	0	S/US	S/US

Course Objective

This course helps to achieve overall health of body and mind and overcome stress

Course Outcomes

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

Unit 1:

Definitions of Eight parts of yog. (Ashtanga)

Unit 2:

Yam and Niyam, Do`s and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Unit 3:

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

Recommended Books :

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

MTA108-18	Credits	L	T	P	Int	Ext
Personality Development Through Life Enlightenment Skills	Non-credit	2	0	0	S/US	S/US

Course Objective

This course helps to learn toachieve the highest goal happily, become a person with stable mind, pleasing personality and determination and awaken wisdom in students

Course Outcomes

Students will be able to

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

Unit 1:

Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom), Verses- 29,31,32 (pride & heroism), Verses- 26,28,63,65 (virtue), Verses- 52,53,59 (dont's), Verses- 71,73,75,78 (do's).

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Unit 2:

Approach to day to day work and duties, Shrimad BhagwadGeeta : 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 3:

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

Recommended Books :

1. “Srimad Bhagavad Gita” by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari’s Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya SanskritSansthanam, New Delhi.