NATIONAL ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai)

K.R.NAGAR, KOVILPATTI

www.nec.edu.in

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATIONS – 2023

CURRICULUM AND SYLLABUS OF

M. E. EMBEDDED SYSTEM TECHNOLOGIES

REGULATIONS 2023

CURRICULUM AND SYLLABUS

SEMESTER – I

S. No	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
Theory Courses								
1.	23ES11C	ARM Core Architectures for Embedded system	PCC	3	0	0	3	3
2.	23ES12C	Research Methodology and IPR	PCC	2	0	0	2	2
3.	23ES13C	Design of Embedded System	PCC	3	0	0	3	3
4.	-	Elective – I	PEC	3	0	0	3	3
5.	-	Elective – II	PEC	3	0	0	3	3
6.	-	Elective – II	PEC	3	0	0	3	3
7.	-	Audit Course – I	AC-1	2	0	0	2	0
Practical Courses								
8.	23ES14C	Embedded Programming Laboratory-I	PCC	0	0	4	4	2
9.	23ES15C	Digital system design Laboratory	PCC	0	0	4	4	2
	TOTAL			**19**	**0**	**8**	**27**	**21**

SEMESTER – II

S. No	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
Theory Courses								
1.	23ES21C	Embedded Linux	PCC	3	0	0	3	3
2.	23ES22C	SoC design for Embedded system	PCC	3	0	0	3	3
3.	-	Elective – IV	PEC	3	0	0	3	3
4.	-	Elective – V	PEC	3	0	0	3	3
5.	-	Elective – V	PEC	3	0	0	3	3
6.	-	Audit Course – II	AC-2	2	0	0	2	0
Practical Courses								
7.	23ES23C	Embedded Programming Laboratory-II	PCC	0	0	4	4	2
8.	23ES24C	Advanced FPGA design Laboratory	PCC	0	0	4	4	2
9.	23ES25C	Mini Project with Seminar	PCC	0	0	4	4	2
	TOTAL			**17**	**0**	**12**	**29**	**21**

SEMESTER – III

S. No	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
Theory Courses								
1.	-	Elective - VI	PCC	3	0	0	3	3
2.	-	Elective - VII	PEC	3	0	0	3	3
3.	-	Elective - VIII	PEC	3	0	0	3	3
4.	-	Elective - IX	PEC	3	0	0	3	3
5.	-	Open Elective	OEC	3	0	0	3	3
Practical Courses								
6.	23ES31C	Project Work – I	PCC	0	0	12	20	6
	TOTAL			**15**	**0**	**12**	**35**	**21**

SEMESTER – IV

S. No	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
Practical Courses								
1.	23ES41C	Project Work – II	PCC	0	0	24	24	12
						TOTAL	**24**	**12**

TOTAL CREDITS - 75

PROGRAMME ELECTIVE COURSES

S. No.	Course Code	Course Title	Category	L	T	P	C
1.	23ES01E	Software for Embedded Systems	PEC	3	0	0	3
2.	23ES02E	Automotive Embedded Systems	PEC	3	0	0	3
3.	23ES03E	Advanced Embedded Systems	PEC	3	0	0	3
4.	23ES04E	Protocols and Architectures for Wireless Sensor Networks	PEC	3	0	0	3
5.	23ES05E	Robotics and Control	PEC	3	0	0	3
6.	23ES06E	VLSI Architecture and Design Methodologies	PEC	3	0	0	3
7.	23ES07E	Embedded Wireless Sensor Networks	PEC	3	0	0	3
8.	23ES08E	Embedded System Security	PEC	3	0	0	3
9.	23ES09E	Distributed Embedded Computing	PEC	3	0	0	3
10.	23ES10E	Machine Learning	PEC	3	0	0	3

11.	23ES11E	Internet of Things	PEC	3	0	0	3
12.	23ES12E	Radar Signal Processing	PEC	3	0	0	3
13.	23ES13E	Semiconductor Device Modelling	PEC	3	0	0	3
14.	23ES14E	Modern Wireless Communications	PEC	3	0	0	3
15.	23ES15E	Signal Integrity for High-speed Design	PEC	3	0	0	3
16.	23ES16E	MEMS and NEMS Technology	PEC	3	0	0	3
17.	23ES17E	Hardware Software co design of embedded system	PEC	3	0	0	3
18.	23ES18E	Embedded Networking	PEC	3	0	0	3

AUDIT COURSES

S. No.	Course Code	Course Title	Category	L	T	P	C
1.	23AC01E	Technical Report Writing	AC	2	0	0	0
2.	23AC02E	Disaster Management	AC	2	0	0	0
3.	23AC03E	Sanskrit for Technical Knowledge	AC	2	0	0	0
4.	23AC04E	Value Education	AC	2	0	0	0
5.	23AC05E	Constitution of India	AC	2	0	0	0
6.	23AC06E	Pedagogy Studies	AC	2	0	0	0
7.	23AC07E	Stress Management by Yoga	AC	2	0	0	0
8.	23AC08E	Personality Development through Life Enlightenment Skills	AC	2	0	0	0

Estd : 1984

23ES11C ARM CORE ARCHITECTURES FOR EMBEDDED SYSTEM **L T P C**
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Distinguish different ARM Processor architectures.
CO 2: Distinguish different ARM Processor instructions sets and their features.
CO 3: Explain about the memory mapping of ARM Processor versions.
CO 4: Discuss about the debugging scheme of ARM Processor.
CO 5: Write the programs with CMSIS of ARM Cortex M3 Processor.

INTRODUCTION **9**

Overview of ARM Architecture Versions –ARM family variants -ARM Programmers model- ARM Architecture Comparison– ARM Architecture implementation examples-Cortex profiles comparison with respect to architectural versions (v7,v8 and v9)

INSTRUCTION SET **9**

ARM processor Instruction Sets types – Unsupported Instructions – Moving Data Instructions – Pseudo Instructions – Data Processing Instructions– Unconditional Branch Instructions – Decision and Conditional Branch Instructions – Combined Compare and Conditional Branch Instructions – Instruction Barrier and Memory Barrier Instructions Saturation Operations – Comparison of ARM,THUMB and THUMB2 instruction sets

MEMORY SYSTEMS AND INTERRUPT SCHEMES **9**

Memory System Features – Comparison of Memory mapping of different architecture versions - Memory Access Attributes – Bit Band Operations– Advantages of Exclusive Accesses – Endian Mode – Pipeline – Bus Interfaces – Other Interfaces – Types of Exceptions – Vector Tables – Fault Exceptions – Interrupt Control – Software Interrupts –Interrupt mechanisms of different architecture versions(v7,v8 and v9)

DEBUGGING ARCHITECTURE **9**

Debugging Features – Core sight Overview – Debug Modes – Debugging Events – Accessing Register Content in Debug – Trace System – Trace Components – DWT, ITM, ETM and TPIU Flash Patch and Breakpoint Unit – Advanced High-Performance Bus Access Port – JTAG and SWD based debugging schemes

ARM CORTEX M PROGRAMMING **9**

Overview of development tools- A typical Development Flow - Simple programs using C - CMSIS: Background, areas of standardization, Organization, Benefits – simple interfacing programs for Cortex-M3 with CMSIS.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Daniel Tabak, “Advanced Microprocessors”, McGraw Hill. Inc., 2nd Edition, 1996.
2. Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, Elsevier, 2nd Edition, 2010.
3. Andrew N.Sloss, Dominic Symes, Chris Wright, “ARM System Developer’s Guide-Designing and Optimizing System Software”, Morgan Kaufmann, 1st Edition, 2004.
4. Steave Furber, “ARM System-On-Chip Architecture”, Addison Wesley, 2nd Edition, 2000.
5. Daniel W. Lewis, “Fundamentals of Embedded Software with the ARM Cortex-M3”, Prentice Hall, 1st Edition, 2012.
6. www.arm.com

23ES12C RESEARCH METHODOLOGY AND IPR **L T P E C**
2 0 0 0 2

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: Understand research problem formulation.
CO2: Analyze research related information.
CO3: Understand the research ethics.
CO4: Understand when IPR would take such important place in growth of individuals & Nation.
CO5: Recognize the importance of Report writing.

RESEARCH FORMULATION AND DESIGN **6**

Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review - primary and secondary sources, reviews, monographs, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research databases, development of working hypothesis – Case study

DATA COLLECTION AND ANALYSIS **6**

Method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statistical packages (SigmaSTAT, SPSS for student t-test, ANOVA, etc.), hypothesis testing – Data Mining (case studies)

RESEARCH ETHICS, IPR AND SCHOLARY PUBLISHING **6**

Ethics - ethical issues, ethical committees (human and animal); IPR- intellectual property rights and patent law, commercialization, copyright, royalty, trade related aspects of intellectual Property rights (TRIPS); scholarly publishing - IMRAD concept and design of research papers; citation and acknowledgement, plagiarism, reproducibility; and accountability

CONTEMPORARY ISSUES IN IPR **6**

Interface between IPR and Human Rights -Interface between IPR and Competition Law -IPR and sustainable development – Impact of Internet on IPR - IPR of Biological systems & E-Commerce.

INTERPRETATION AND REPORT WRITING **6**

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

L: 30; TOTAL: 30 PERIODS

REFERENCES

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., An introduction to Research Methodology-‖, RBSA Publishers, 2015
2. Kothari, C.R., Research Methodology: Methods and Techniques‖, New Age International, 2018 (Unit 1, Unit 2, Unit 5).
3. Wadehra, B.L. Law relating to patents, trademarks, copyright designs and geographical indications‖. Universal Law Publishing, Reprint, 2011. (Unit 3, Unit 4)
4. Anthony, M., Graziano, A.M. and Raulin, M.L. Research Methods: A Process of Inquiry, Allyn and Bacon 2012.
5. Carlos, C.M., Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York, 2000.

23ES13C DESIGN OF EMBEDDED SYSTEM L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Explain the basic concepts, Building Blocks of Embedded System.
CO 2: Discuss about the serial data communication and interrupt mechanism.
CO 3: Explain about the task management using RTOS.
CO 4: Use GNU C to develop embedded application.
CO 5: Write the programs for character device driver.

INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems –Classifications- selection of embedded processor-on chip processor memory types- external EEPROM interfacing for data storage–data representation and its orientation in memory concept- data manipulation in registers using logical operations- real world analog and digital sensor data conversion -Timer concept and Real Time Clock.

EMBEDDED NETWORKING AND INTERRUPT MECHANISM 9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols - RS232 standard – CAN – Inter Integrated Circuits (I2C) – Difference between interrupt and exception-Programmed-I/O busy-wait approach without interrupt service mechanism- interrupt sources in Cortex M3 processor- simple programs using external and internal interrupt.

RTOS BASED EMBEDDED SYSTEM DESIGN 9

Concept of user space and kernel space - Introduction to basic concepts of RTOS- Task, thread & process, context switching interrupt routines in RTOS- Multiprocessing and Multitasking- Preemptive scheduling and -rate monotonic scheduling policy with examples- Task management scheme in µC/OS-III with examples -Interprocess Communication using semaphores and Mailbox with examples

SOFTWARE FOR EMBEDDED SYSTEMS 9

Concept of different software programs associated with embedded system design-Introduction to GCC - Debugging with GDB - Make utility - GNU Configure and Build System - GNU Binary utilities - Profiling - using gprof - Memory Leak Detection with valgrind - Introduction to GNU C Library-simple make file scripts.

DEVICE DRIVER CONCEPTS 9

Classification of different device drivers-Introduction to character driver – Development environment – procedure for character driver development in Linux environment - simple character driver programs.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Rajkamal, “Embedded system-Architecture, Programming, Design”, TMH, 2011.
2. Tammy Noergaard, ”Embedded System Architecture, A comprehensive Guide for Engineers and Programmers”, Elsevier, 2006
3. Lyla B Das,” Embedded Systems-An Integrated Approach”, Pearson 2013 www.gnu.org
4. M.Tim Jones, “GNU/Linux Application Programming” Charles River Media programming series, 2008
5. Sree Krishnan Venkateswaran, “Essential Linux Device Drivers”, Prentice Hall,2008

23ES14C	**EMBEDDED PROGRAMMING LABORATORY-I**	**L T P C**
		0 0 4 2

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Perform interfacing on chip and peripherals with Cortex M processor.

LIST OF EXPERIMENTS

1. Time delay program using built in Timer / Counter feature
2. External Interrupt based decision taking system
3. Ultrasonic sensor Interface
4. Displaying a message in a 2 line X 16 Characters LCD display
5. ADC and Temperature sensor LM 35 Interface
6. 1^2C Interface – 7 Segment display
7. GPIO interface using CMSIS
8. Serial communication using CMSIS
9. ENCODER interface using CMSIS
10. Wi-Fi communication using Wi-Fi modules

P: 60; TOTAL: 60 PERIODS

23ES15C	**DIGITAL SYSTEM DESIGN LABORATORY**	**L T P C**
		0 0 4 2

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Write HDL code for digital integrated circuit and Import the logic modules into FPGA Boards

LIST OF EXPERIMENTS

Module Design using Verilog / VHDL and implement in FPGA board

1. Adders Subtractors and Multiplier
2. ALU circuit
3. Universal Shift Registers
4. Asynchronous and synchronous Counters
5. Finite State Machine (Moore/Mealy) and its applications
6. Memories
7. UART protocol based logic block
8. I2C protocol based logic block
9. GPIO logic block

P: 60; TOTAL: 60 PERIODS

23ES21C EMBEDDED LINUX L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Understand important elements of Embedded Linux system
CO 2: Explain the architecture of .Linux based system
CO 3: Explain about the build process of embedded Linux system.
CO 4: Write the kernel modules
CO 5: Distinguish user space and kernel space programs

COMPONENTS OF EMBEDDED LINUX SYSTEMS 9

Linux-based embedded system components-Reference hardware model-Reference hardware model implementations- CPU memory map- The role of the bootloader-Possible scenarios. An example of bootloader operations - Linux kernel-Device tree-- Typical layout of the root filesystem.

ARCHITECTURE OF EMBEDDED LINUX SYSTEM 9

Linux architecture-Conceptual view of the kernel-Process scheduler- Memory manager- external interfaces, Memory manager architecture-Virtual file system, i-node, i-node interface- File interface, Virtual file system architecture- Inter-process communication architecture - Device tree example for the UDOO NEO, Device tree syntax, Device tree content, Device tree addressing-The U-Boot bootloader - UDOO NEO boot process, An example: UDOO NEO boot process.

BUILD PROCESS 9

Introduction: The workflow, Build systems- BuildrootvsYocto – general aspects, Buildroot vs Yocto – configuration, Buildroot vsYocto – purpose-The Yocto Project: The Yocto build system, The build system workflow- configuration files– user configuration, Metadata, Machine (BSP) configuration-The build system workflow – Distribution policy- source fetching- patching,

The build system workflow – configure/compile/install, The build system workflow – output analysis/packaging-image generation, SDK generation.

INTRODUCTION TO LINUX KERNEL MODULES 9

Introduction:CPU – I/O interface, CPU – I/O interface with polling, CPU – I/O interface with interrupt, CPU – I/O interface, CPU – I/O interface latency- Direct memory access (DMA) architecture, Direct memory access (DMA) transfer modes- The Virtual File System (VFS) abstraction, VFS – an example, VFS functions – include/linux/fs.h-The device file concept, Linux kernel modules: the initialization function, the cdev data structure, the initialization function the clean-up function, custom VFS functions.

COMMUNICATION BETWEEN KERNEL AND USERSPACE 9

Introduction: The reference use case, The CPU/Device interface, The module level, The module level – file operations, ioctl() implementation, open()/release() implementation, read() implementation-Passing data to/from the kernel– write() implementation- The module level – communication with the device, Memory mapped I/O- initialization, - clean-up, Memory mapped I/O – read, write- GPIO-based I/O – initialization,– clean-up,– read, write-Interrupts, Requesting the interrupt line, Freeing the interrupt line, The interrupt handler, Interrupt handling, Top-half and bottom-half, Needed support, Work queue, The user level, The user level – the application.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Christoper Collinan, 'Embedded Linux primer ', Prentice Hall, 2006.
2. Richard Jones, "Beginning Linux Programming", Wiley Publishing Inc, 2008.
3. Craig Hollabaugh, "*Embedded Linux: Hardware, Software and Interfacing*", Pearson Education, 2002.
4. http://www.armcommunity.com
5. http://www.arm.com/resources/education/education- kits
6. Doug Abbott, "*Linux for embedded and real time applications*", Elsevier Science, 2003.

23ES22C **SoC DESIGN FOR EMBEDDED SYSTEM** **L T P C**
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Understand the components of a System-on-Chip and an embedded system
CO2: Select the processor for SoC design
CO3: Understand the concept behind the memory element in system of chip
CO4: Distinguish the various interconnect architectures
CO5: Understand the FPGA Processors for SoC design

SYSTEM ARCHITECTURE: OVERVIEW **9**

Components of the system – Processor architectures – Memory and addressing – system level interconnection – SoC design requirements and specifications – design integration – design complexity – cycle time, die area and cost, ideal and practical scaling, area-time-power tradeoff in processor design, Configurability.

PROCESSOR SELECTION FOR SOC **9**

Overview – soft processors, processor core selection. Basic concepts – instruction set, branches, interrupts and exceptions. Basic elements in instruction handling – Minimizing pipeline delays – reducing the cost of branches – Robust processors – Vector processors, VLIW processors, Superscalar processors.

MEMORY SYSTEM **9**

SoC external memory, SoC internal memory, Scratch pads and cache memory – cache organization and write policies – strategies for line replacement at miss time – split I- and D-caches – multilevel caches – SoC memory systems – board based memory systems – simple processor/memory interaction.

INTERCONNECT ARCHITECTURES AND SOC CUSTOMIZATION **9**

Bus architectures – SoC standard buses – AMBA, Core Connect – Processor customization approaches – Reconfigurable technologies – mapping designs onto reconfigurable devices - FPGA based design – Architecture of FPGA, FPGA interconnect technology, FPGA memory, Floor plan and routing.

FPGA BASED EMBEDDED PROCESSOR **9**

Hardware software task partitioning – FPGA fabric Immersed Processors – Soft Processors and Hard Processors – Tool flow for Hardware/Software Co-design –Interfacing Processor with memory and peripherals – Types of On-chip interfaces – Wishbone interface, Avalon Switch

Matrix, OPB Bus Interface, Creating a Customized Microcontroller - FPGA-based Signal Interfacing and Conditioning.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Michael J. Flynn and Wayne Luk**,** “Computer System Design: System-on-Chip”, John Wiley and sons, 2011.
2. Rahul Dubey, “Introduction to Embedded System Design Using Field Programmable Gate Arrays”, Springer Verlag London Ltd., 2009.
3. Sudeep Pasricha and Nikil Dutt, On-Chip Communication Architectures - System on Chip Interconnect”, Elsevier, 2008.
4. Michael Keating and Pierre Bricaud, "Reuse Methodology Manual for System -On-A-Chip Designs", Third Edition, Kluwer Academic Publishers, 2002.
5. "Embedded Design Handbook - FPGA CPLD and ASIC", Intel, 2018.

23ES23C **EMBEDDED PROGRAMING LABORATORY- II** **L T P C**
0 0 4 2

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Develop kernel modules using yocto build environment

LIST OF EXPERIMENTS

1. Introduction to UDOO NEO Board and workspace setup
2. Custom embedded Linux system build using manual approach
3. Build simple kernel modules using yocto
4. Handling GPIO using kernel modules
5. HandlingHC-SR04Rangingsensorusingkernelmodules
6. Cross compile applications using yocto
7. Profile the execution of code using ARMDSS Streamline.

P: 60; TOTAL: 60 PERIODS

23ES24C **ADVANCED FPGA DESIGN LABORATORY** **L T P C**
0 0 4 2

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Design logic blocks in the FPGA Chip Set Boards

LIST OF EXPERIMENTS

1. Synthesize and implement Combinational and Sequential Circuits in VERILOG / VHDL
2. Synthesize and implement MAC unit and GCD unit in Verilog /VHDL
3. Implementation of sampling of input signal and display in FPGA Synthesize and

a. implement FIR filter and IIR filter Verilog /VHDL

4. Synthesize and implement 8 bit general purpose processor in Verilog/VHDL
6. Synthesize and implement UART and USART

b. Simulation and Analysis of CMOS combinational and sequential logic circuits using CAD tools

7. customized Logic blocks implementation in Zync FPGA Boards

P: 60; TOTAL: 60 PERIODS

23ES25C **MINI PROJECT WITH SEMINAR** **L T P C**
0 0 4 2

During the seminar session, each student is expected to prepare and present a topic on Embedded System technology, for duration of about 15 to 20 minutes. Each student is expected to present atleast twice during the semester and the student is evaluated based on the presentation skill, concept and Query clarification. At the end of the semester, he / she can submit a report on his / her topic of seminar and marks are given based on the report. A Faculty is to be allotted and he / she will guide and monitor the progress of the student and maintain the attendance also. The seminar will be assessed by a committee appointed by the COE.

P: 60; TOTAL: 60 PERIODS

Estd : 1984

23ES01E SOFTWARE FOREMBEDDED SYSTEM L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Understand elements of C Programming language
CO 2: Use GNU C to develop embedded software.
CO 3: Explain about the concept of using C language keywords to embedded programming.
CO 4: Discuss about the features of eCOS.
CO 5: Write simple programs with mPython for embedded system.

EMBEDDED PROGRAMMING 9

C and Assembly - Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers Debugging and Optimization – In-line Assembly

C PROGRAMMING TOOL CHAIN IN LINUX 9

C preprocessor - Stages of Compilation - Introduction to GCC - Debugging with GDB - The Make utility - GNU Configure and Build System - GNU Binary utilities - Profiling - using gprof - Memory Leak Detection with valgrind - Introduction to GNU C Library

EMBEDDED C 9

Adding Structure to 'C' Code: Object oriented programming with C, Header files for Project and Port,Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.

EMBEDDED OS 9

Basis of a simple embedded OS-Introduction to eCOS- architecture - Portability issue-Important design considerations when using eCOS **-** Memory requirements - embedding serial communication & scheduling data transmission - Case study: Intruder alarm system

PYTHON PROGRAMMING 9

Basics of PYTHON Programming Syntax and Style – Python Objects– Dictionaries – comparison with C programming on Conditionals and Loops – Files – Input and Output – Errors and Exceptions – Functions – Modules – Classes and OOP – Execution Environment.-simple programs in mPython for embedded system

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Steve Oualline, 'Practical C Programming 3rd Edition', O'Reilly Media, Inc, 2006.
2. Michael J Pont, "Embedded C", Pearson Education, 2007.
3. Christian Hill, "Learning Scientific Programming with Python", Cambridge University Press, 2016.
4. http://www.ecos.sourceware.org
5. David Griffiths, Dawn Griffiths, "Head First C", O'reilly,2015.

23ES02E AUTOMOTIVE EMBEDDED SYSTEMS L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Describe various components associated with ECU unit
CO2: Understand various ARM board interconnection mechanism
CO 3: Identify various sensors needed for control parameters sensing
CO 4: Discuss electronic ignition system
CO 5: Explain the bus protocols in automotive control

ELECTRONICS IN THE AUTOMOBILE 9

Introduction- Body and convenience electronics - vehicle power supply controllers and lighting modules, door control modules, Safety electronics - active safety systems: ABS, ASR, ESP passive safety systems: Restraint systems and their associated sensors in an automobile.- Powertrain Electronics:Gasoline engine management, Infotainment electronics: Dashboard/instrument cluster, car audio, telematic systems navigation systems multimedia systems cross application technologies.

DRIVE BY WIRE 9

Challenges and opportunities of X-by-wire: system & design requirements, steer-by-wire, brake-by-wire, suspension-bypwire, gas-by-wire, power-by-wire, shift by wire.

HARDWARE MODULES 9

Basic sensor arrangement, types of sensors such as- oxygen sensors, crank angle position sensors- Fuel metering vehicle speed sensors and destination sensors, Attitude sensor, Flow sensor, exhaust temperature, air mass flow sensors. Throttle position sensor, solenoids, stepper motors, relays.

ELECTRONIC IGNITION SYSTEMS 9

Electronic ignition systems. types of solid state ignition systems and their principle of operation Digital engine control system. Open loop and closed loop control system, Engine cranking and warm up control. Acceleration enrichment. Deceleration learning and ideal speed control Distributor less ignition – Integrated engine control system, Exhaust emission control engineering.

BUS PROTOCOLS IN AUTOMOTIVE CONTROL 9

Flex Ray Protocol-Protocol Architecture and application, Multiprocessor communication using CAN bus, Case study- cruise control of car, Artificial Intelligence and engine management.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Frank Vahid and Tony Givargi ,“Embedded System Design: A unified Hardware / Software Introduction” , Wiley India Publishers,2006
2. Patrick R. Schaumont, “A Practical Introduction to Hardware/Software Co-Design”,Springer Publishers,2010.
3. Nicolas Navet and Francoise Simonot -Lion, “Automotive Embedded Systems hand Book”, Taylor & Francis Group, CRC Press / BSP Books, 2013.

23ES03E ADVANCED EMBEDDED SYSTEMS L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Describe the concepts of embedded cyber physical modeling (K2)
CO 2: Explain the system modeling and partitioning of hardware and software (K2)
CO 3: Analyze the hardware &software co-synthesis and concurrent design process models. (K3)
CO 4**:** Understand the analysis and verification of cyber physical modeling (K2)

INTRODUCTION TOEMBEDDED CYBER PHYSICALMODELING 9

Introduction – Modeling Dynamic Behaviors – Continuous Dynamics – Newtonian Mechanics, Actor Models, Properties of system, Feedback Control – Discrete Dynamics – Discrete systems, The notion of state, Finite-State Machines, Extended State Machines, Non determinism, Behaviors and Traces – Hybrid systems – Modal Models, Classes of Hybrid systems.

SYSTEM MODELLING WITH HARDWARE/SOFTWARE PARTITIONING 9

Embedded systems Hardware/Software Co-Design - System Specification and modeling , Single-processor Architectures &Multi-Processor Architectures, comparison of Co Design Approaches, Models of Computation, Requirements for Embedded System Specification, Hardware/Software Partitioning Problem, Hardware/Software Cost Estimation, Generation of Partitioning by Graphical modeling, Formulation of the HW/SW scheduling, Optimization.

HARDWARE/SOFTWARE CO-SYNTHESIS 9

The Co-Synthesis Problem, State - Transition Graph, Refinement and Controller Generation, Distributed System Co-Synthesis.

CONCURRENT PROCESS MODELS AND HARDWARESOFTWARECO-DESIGN 9

Modes of operation - Finite state machines models - HCFSL and state charts language – state machine models - Concurrent process model - Concurrent process communication - Synchronization among process - Implementation- Data Flow model - Automation synthesis - Hardware software co-simulation - IP cores - Design Process Model.

ANALYSIS AND VERIFICATION OF CYBER PHYSICAL MODELING 9

Invariants and Temporal Logic – Invariants, Linear Temporal Logic, Equivalence and Refinement – Models as specifications, Type Equivalence and Refinement, Language Equivalence and Containment, Simulation, Bisimulation.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Edward Ashford Lee and Sanjit Arunkumar Seshia, “Introduction to Embedded Systems - A Cyber-Physical Systems Approach”, 2nd Edition, MIT Press, 2016.
2. David. E. Simon, "An Embedded Software Primer", Pearson Education, 2001.
3. Tammy Noergaard, "Embedded System Architecture, A comprehensive Guide for Engineers and Programmers", Elsevier,2006
4. Raj Kamal, "Embedded Systems - Architecture, Programming and Design”, Tata McGraw Hill, 2006.
5. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & Sons, 2002.
6. Jorgen Staunstrup, Wayne Wolf, "Hardware/Software Co-Design: Principles and Practice", Kluwer Academic Pub, 1997.
7. Giovanni De Micheli, Rolf Ernst Morgon, “Readingin Hardware/Software Co - Design”, Kaufmann Publishers, 2001.

23ES04E PROTOCOLS AND ARCHITECTURE OF WIRELESS SENSOR NETWORKS

L	T	P	C
3	0	0	3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Discuss the basic concepts and architecture of wireless sensor networks.
CO 2: Explain different network protocols.
CO 3: Explain infrastructure establishment for WSN Networks.

ARCHITECTURE 9

Challenges for Wireless Sensor Network-Single node architecture-Energy consumption of sensor nodes-Some examples of sensor nodes-Sensor network scenarios-Optimization goals and figure of merit-Gateway concepts.

PHYSICAL LAYER 9

Frequency allocation -Modulation and Demodulation-Wave propagation effects and noise-Channel models-Energy usage profiles-Choice of modulation scheme-Dynamic modulation scaling.

MAC AND LINK PROTOCOLS 9

Fundamentals of MAC protocols-Low duty cycle protocol and wakeup concepts-Contention based protocols-Schedule based protocols-IEEE 802.15.4 MAC protocols-Error control protocols.

ROUTING PROTOCOLS 9

Gossiping and agent based unicast forwarding-Energy efficient unicast-Broadcast and Multicast - Geographic routing -Mobile nodes.

INFRASTRUCTURE ESTABLISHMENT 9

Topology control – Clustering-Time synchronization-Localization and Positioning Sensor Tasking and Control - Medicine and Health care-Environmental disaster monitoring.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
3. BhaskarKrishnamachari, “Networking Wireless Sensors”, Cambridge Press, 2005.
4. Mohammad IlyasAndImadMahgaob, “Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems”, CRC Press, 2005.
5. Wayne Tomasi, “Introduction to Data Communication and Networking”, Pearson Education, 2007.

23ES05E **ROBOTICS AND CONTROL** **L T P C**
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Define the basic robot terminologies.
CO 2: Discuss the concepts of kinematics and Jacobians in robot control
CO 3: Explain the basis of robot dynamics
CO 4: Discuss the path planning and robot control techniques

INTRODUCTION AND TERMINOLOGIES **9**

Definition - Classification - History - Robots components - Degrees of freedom - Robot joints coordinates- Reference frames - workspace-Robot languages-actuators - sensors- Position, velocity and acceleration sensors -Torque sensors-tactile and touch sensors - proximity and range sensors –social issues.

KINEMATICS **9**

Mechanism-matrix representation-homogenous transformation-DH representation – Inverse kinematics - solution and programming-degeneracy and dexterity.

DIFFERENTIAL MOTION AND PATHPLANNING **9**

Jacobian-differential motion of frames-Interpretation-calculation of Jacobian-Inverse Jacobian-Robot Path planning.

DYNAMIC MODELLING **9**

Lagrangian mechanics- Two - DOF manipulator- Lagrange-Euler formulation – Newton Euler formulation – Inversedynamics.

ROBOT CONTROLSYSTEM **9**

Linear control schemes- joint actuators- decentralized PID control- computed torquecontrol– force control- hybrid position force control- Impedance/ Torque control.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. R.K. Mittal and I J Nagrath, “Robotics and Control”, Tata McGraw Hill, 4th Reprint, 2003.
2. Saeed B. Niku, "Introduction to Robotics ", Pearson Education,2002
3. K.S.Fu, R.C.Gonzalez and C.S.G.Lee, "Robotics Control, Sensing, Vision and Intelligence", Tata McGraw Hill, 2nd Reprint,2008.
4. R.D.Klafter, TA Chmielewski and Michael Negin, "Robotic Engineering, An Integrated approach", Prentice Hall of India, 2003.
5. Reza N.Jazar, “Theory of Applied Robotics Kinematics, Dynamics and Control”, Springer, 1st Indian Reprint, 2010.

23ES06E VLSI ARCHITECTURE AND DESIGN METHODOLOGIES **L T P C**
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1 : Design CMOS Transistor level circuit for the given logic
CO2 : Explain the VLSI design aspects of operational amplifier
CO3 : Distinguish different FPGA Architectures
CO4 :Explain the concepts of ASIC
CO5 : Write the Verilog coding for digital circuits

CMOS DESIGN **9**

Overview of digital VLSI design methodologies - Logic design with CMOS transmission gate circuits-Clocked CMOS-dynamic CMOS circuits, Bi-CMOS circuits- CMOS IC technology - Stick diagram for all basic gates, Layout diagram for Inverter.

ANALOG VLSI DESIGN **9**

Introduction to analog VLSI- Design of 2 stage and 3 stage Op Amp -High Speed and High frequency Op Amps-Super MOS-Analog primitive cells.

PROGRAMMABLE LOGIC DEVICES **9**

Generic Architecture of FPGA – Functional blocks - I/O blocks – Interconnects - Programming Techniques - Anti fuse – SRAM-EPROM and EEPROM technology – Spartan VI: Functional Block Diagram and features - Cyclone V: Functional Block Diagram and features

ASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENTAND ROUTING ***9***

System partitioning - Partitioning methods- floor planning – placement and routing - global routing - detailed routing - detailed routing - special routing- circuit extraction – Design Rule checker.

VERILOG HDL ***9***

Introduction to Verilog HDL, hierarchical modeling concepts, modules and port definitions, gate level modeling, data flow modeling, behavioral modeling, task & functions, Verilog Simulation and synthesis, Verilog coding for Carry Look ahead adder, Multiplier, ALU, Shift Registers using structural modeling – Multiplexer, Sequence detector Traffic light controller using behavioralmodeling.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. M.J.S Smith, "Application Specific integrated circuits", Pearson Education, 5th Reprint, 2008.
2. Kamran Eshraghian, Douglas A. Pucknell and Sholeh Eshraghian, "Essentials of VLSI circuits and system", Prentice Hall India, 2005.
3. Wayne Wolf, “Modern VLSI design”, Pearson Education, 3rd Edition, 2007.
4. Mohamed Ismail, TerriFiez, "Analog VLSI Signal and information Processing", McGraw Hill International Editions, 1994.
5. Samir Palnitkar, "Verilog HDL, A Design guide to Digital and Synthesis", Pearson, 2nd Edition, 2005.

23ES07E EMBEDDED WIRELESS SENSOR NETWORKS L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Explain the basics of wireless sensor networks.

CO 2: Discuss about the sensor network components, architecture and design principles of WSN

CO 3: Explain the need of Physical layer design challenges and MAC Protocals

CO 4: Design the Smart Sensors and Applications of WSN

OVERVIEW OF WIRELESS SENSOR NETWORKS 9

Challenges for Wireless Sensor Networks - Characteristics requirements - Required mechanisms, Difference between mobile ad-hoc and sensor networks- Enabling Technologies for Wireless Sensor Networks. Single-Node Architecture - Hardware Components - Energy Consumption Sensor Nodes Operating Systems and Execution Environments - Sensor node Examples: EYES, MICA, MICAZ motes.

NETWORK ARCHITECTURE 9

Sensor Network Scenarios – Optimization goals and Figure of Merit – Design principles for WSNs – Gateway concepts.

PHYSICAL LAYER AND MAC PROTOCALS 9

Wireless Channel and communication fundamentals – Physical layer and transceiver design considerations in WSN – Fundamentals of MAC Protocals- Low duty cycle protocals and wakeup concepts – Contention based protocals - Schedule based protocals – IEEE 802.15.4 MAC protocol.

SMART SENSORS 9

Introduction to Smart Sensors – Signal Conditioning Circuits – Architecture of Smart Sensors Humidity Sensors – Soil Moisture Sensors– Temperature Sensors – Color Sensors – LevelSensors.

APPLICATIONS AND PROTOCOL IMPLEMENTATIONONWSN 9

Home control - Medical Applications - Civil and Environmental Engineering applications – Wildfire monitoring - Habitat monitoring. Embedding LEACH protocol on ARM7 TDM microcontroller using embedded C language - Embedding Cryptographic algorithms on ARM 7 TDM microcontroller using embedded C language – FPGA based customizable event driven architecture.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Feng Zhao & Leonidas J.Guibas, “Wireless Sensor Networks An Information Processing Approach", Elsevier, 2007.
2. Kazem Sohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks- Technology, Protocols and Applications”, John Wiley, 2012.
3. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
4. Bhaskar Krishnamachari, “Networking Wireless Sensors”, Cambridge Press, 2005.
5. Mohammad Ilyas and Imad Mahgaob, “Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems”, CRC Press, 2005.

23ES08E EMBEDDED SYSTEM SECURITY **L T P C**
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Gain the knowledge of cryptographic concepts in the context of Embedded system.
CO 2: Understand public key encryption techniques and applications of secure hash functions.
CO 3: Categorize attacks and threats related to the system and its defense mechanism
CO 4:Deliberate the format and functionality of different Network Security Protocols
CO 5: Realize the principle aspects of a comprehensive security strategy in Embedded systems.

SYMMETRIC CIPHERS **9**

OSI Security Architecture - Security Services, Security Attacks, Security Mechanism. Overview - Classical Encryption Techniques - Block Ciphers and the Data Encryption standard Introduction to Finite Fields - Advanced Encryption standard – Contemporary Symmetric Ciphers - Confidentiality using Symmetric Encryption.

PUBLIC-KEY ENCRYPTION AND HASH FUNCTIONS **9**

Introduction to Number Theory - Public-Key Cryptography and RSA - Key Management – Diffie Hellman Key Exchange - Elliptic Curve Cryptography - Hash Functions – Hash Algorithm - SHA-1 – Digital Signatures.

SYSTEM SECURITY **9**

Introduction - Access Control, Intrusion Detection and Prevention. Firewalls: Firewall Design Principles - Firewall Characteristics, Types of Firewalls. Trusted System. Malicious Softwares: Virus, Trojan Horse, Ad ware/ Spy ware, Worms, Logic Bomb.Cyber Law and Forensics - IT ACT 2000, Cyber Forensics.

NETWORK SECURITY **9**

Introduction to Network Concepts, OSI Layers and Protocols, Network Devices, Network layer Security (IPSec) - IP Security Overview, IPSec Architecture, Authentication header, Encapsulating security Payload, Combining Security Associations, Key management. Transport Layer Security - SSL/TLS, SET. Application Layer Security - Authentication Applications, Kerberos, X. 509 Authentication Services. E-mail Security – PGP, S/MIME.

EMBEDDED SECURITY **9**

Introduction, Types of Security Features – Physical, Cryptographic, Platform. Kinds ofDevices – CDC, CLDC. Embedded Security Design, Keep It Simple and StupidPrinciple, Modularity Is Key, Important Rules in Protocol Design, Miniaturization ofsecurity, Wireless Security, Security in WSN.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. William Stallings, "Cryptography and Network Security - Principles And Practices", Pearson Education, 3rd Edition, 2003.
2. AtulKahate, "Cryptography and Network Security", Tata McGraw Hill,2003
3. Bruce Schneier, "Applied Cryptography", John Wiley and Sons Inc, 2001.
4. C.SivaRam Murthy, B.S.Manoj, “Adhoc Wireless Networks: Architectures and Protocols”, Prentice Hall, 2004.
5. Timothy Stapko, “Practical Embedded Security: Building Secure Resource Constrained Systems” -, Publisher Newnes.
6. Mai, "Modern Cryptography: Theory and Practice", Pearson Education, 1st Edition, 2003.

23ES09E DISTRIBUTED EMBEDDED COMPUTING L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Discuss the hardware infrastructure of distributed system.
CO 2: Explain the concepts of internet
CO 3: Describe streaming, serialization and networking in JAVA
CO 4: Explain about embedded agent and co-ordination mechanisms
CO 5: Discuss the architecture of embedded computing and design methodologies

THE HARDWARE INFRASTRUCTURE 9

Broad Band Transmission facilities – Open Interconnection standards – Local Area Networks – Wide Area Networks – Network management – Network Security – Cluster computers.

INTERNETCONCEPTS 9

Capabilities and limitations of the internet – Interfacing Internet server applications to corporate databases HTML and XML Web page design and the use of active components.

DISTRIBUTED COMPUTING USING JAVA 9

IO streaming – Object serialization – Networking – Threading – RMI – multicasting distributed databases – embedded java concepts – case studies.

EMBEDDED AGENT 9

Introduction to the embedded agents – Embedded agent design criteria – Behaviour based, Functionality based embedded agents – Agent co-ordination mechanisms and benchmarks embedded-agent. Case study: Mobile robots.

EMBEDDED COMPUTING ARCHITECTURE 9

Synthesis of the information technologies of distributed embedded systems – analog/digital co-design – optimizing functional distribution in complex system design – validation and fast prototyping of multiprocessor system-on-chip – a new dynamic scheduling algorithm for real-time multiprocessor systems.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Deitel & Deitel, “JAVA How to Program”, Prentice Hall, 10th Edition,2014.
2. Sape Mullender, “Distributed Systems”, Addison-Wesley,1993.
3. George Coulouris, Jean Dollimore, Tim Kindberg, “Distributed Systems – Concepts and Design”, Pearson Education, 4th Edition,2009.
4. Bernd Kleinjohann, “Architecture and Design of Distributed Embedded Systems”, C - lab, Universitat Paderborn, Germany, Kluwer Academic Publishers, Boston, April 2001, 248pp.

23ES10E MACHINE LEARNING L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Understand the concept of how to learn patterns and concepts from data
CO 2: Explore unsupervised learning paradigms of machine learning.
CO3: Understand the specific features of reinforcement learning
CO 4: Discuss Machine learning in IOT applications.
CO 5: Discuss Machine learning applications across industries

SUPERVISED LEARNING BASIC METHODS 9

Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods Beyond Binary Classification.

UNSUPERVISED LEARNING CLUSTERING 9

K-means/Kernel K-means Dimensionality Reduction: PCA and kernel PCA Matrix Factorization and Matrix Completion Generative Models (mixture models and latent factor models)
Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests).

REINFORCEMENT LEARNING 9

Need and specific features of reinforcement learning-Markov decision-Montecorlo prediction-Case study: Next best offer, Dynamic pricing.- Inference in Graphical Models, Introduction to Bayesian Learning and Inference.

MACHINE LEARNING FOR IOT APPLICATIONS 9

Recent trends in various learning techniques of machine learning and classification methods for IOT applications, Introduction to Various models for IOT applications.

MACHINE LEARNING APPLICATIONS ACROSS INDUSTRIES 9

Machine Learning Applications across Industries (Healthcare, Manufacturing, Hospitality)-Study on Cloud Based ML offerings.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Kevin Murphy, 'Machine Learning: A Probabilistic Perspective', MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, "The Elements of Statistical Learning", 2nd Edition, Springer, 2009.

23ES11E INTERNET OF THINGS L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Understand the architectural elements of IOT system
CO 2: Identify different protocols of IOT system.
CO 3: Understand the functional elements of IOT system
CO 4: Explore ARM IOT Platforms.
CO 5: Explain different IoT applications

INTRODUCTION **9**

Definitions and Functional Requirements –Motivation – Architecture - Web 3.0 View of IoT Ubiquitous IoT Applications – Four Pillars of IoT – DNA of IoT Middleware for IoT: Overview – Communication middleware for IoT : Open Sensor Web Architecture.

IoT PROTOCOLS **9**

Protocol Standardization for IoT – Efforts –Binary Web Service (BWS) protocol -M2M and WiFi Protocols – TinyREST Protocols –Unified Data Standards – Protocols – IEEE 802.15.4

ELEMENTS OF IoT **9**

IoT system functional diagram- Three functional elements: Hardware (made up of sensors, actuators and embedded communication hardware), middleware (on demand storage and computing tools for data analytics), Presentation (to understand visualization and interpretation tools which can be widely accessed on different platforms and which can be designed for different applications) Enabling technologies for functional elements of IoT: Radio Frequency Identification (RFID) , Wireless Sensor Networks monitoring scheme, Addressing schemes such as Uniform Resource Name (URN) system and IPv6, Data storage and analytics, Visualization. Communication through Bluetooth and Zigbee –WiFi module for IoT: WiSmart EC19D01.

ARM®mbed™IoT DEVICE PLATFORM **9**

Embed platform for IoT:functional block diagram- mbed OS architecture- mbed device driver architecture- mbed tools- mbed for smart home- mbed for wearables.-Introduction about Trillion platform

APPLICATIONS **9**

Internet of Things for Environment monitoring - Internet of Things for Smart Grid – IoT for Agriculture.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012.
2. Dieter Uckelmann; Mark Harrison; Florian Michahelles, “Architecting the Internet of Things”, Springer, 2011.
3. International Journal of Computer Science & Engineering Survey (IJCSES) Vol.2, No.3, August 2011.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key applications and Protocols”, Wiley, 2012.
5. CharalamposDoukas, "Building Internet of Things with the Arduino", Create space, April 2002.
6. T. Luckenbach, P. Gober, S. Arbanowski, A. Kotsopoulos, and K. Kim, “TinyREST a protocol for integrating sensor Networks into the internet”, REALWSN, 2005.
7. Angelo P. Castellani,, “Architecture and Protocols for the Internet of Things: A Case Study”**,** Department of Information Engineering, University of Padova, Italy, 8th IEEE International Conference on Pervasive Computing and Communications, 2010

23ES12E RADAR SIGNAL PROCESSING L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Understand Radar Signal Processing Concepts.
CO 2: Explain different Target Recognition techniques.
CO 3: Use Time Frequency analysis for Target recognition.
CO 4: Use SAR and ISAR images for Target recognition.

INTRODUCTION TO RADAR SYSTEMS 9

Radar signal models - Radar Range Equation - Radar cross section - Range and angular resolution - Distributed Targets - Range Equation - Volume and Area Target Range Equation - RCS of complex targets - Statistical Models of RCS - Swerling RCS models - Noise and Signal to Noise Ratio - Clutter and Jamming - Doppler Shift - Spatial Doppler Shift - Pulsed radar - data acquisition - Nyquist and fast time sampling - Slow time sampling - Range and Doppler ambiguity - Straddle loss - Spatial and angular sampling - I/Q Errors and correction - Digital I/Q .

RADAR WAVEFORMS 9

Matched filter - Range Resolution - Matched filtering of moving targets - Ambiguity function - Pulse burst waveform - Pulse burst ambiguity function - Pulse compression - LFM waveform – Side lobe control - Stretch processing - Barker coded waveforms – Poly phase codes - MTI concept - Pulse cancellers - Pulsed Doppler processing - DFT as a matched filter - Ambiguity resolution techniques - Binary integration.

CFAR DETECTION 9

Cell Averaging CFAR – Effect of varying PFA – Cell Averaging CFAR concept - CFAR reference windows – Analysis of cell averaging CFAR - Cell averaging CFAR limitations – Extensions to Cell Averaging CFAR – Order Statistics CFAR – Adaptive CFAR - Clutter map CFAR - Distribution free CFAR - Two parameter CFAR - Distribution free CFAR.

FREQUENCY AND TIME DOMAIN ANALYSIS OF RADAR SIGNATURE 9

Helicopter recognition - Blade flash parameters - Detection of blade flash - Extraction of a blade flash from radar data - Helicopter classification using blade flash – Main rotor spectrum - Jet engine recognition - Interaction of radar signal with engine blades - JEM spectrum - Front rotor stage spectrum - Jet engine recognition from JEM spectrum - Spectral analysis and jet engine recognition – Target recognition using Synthetic Aperture Radar and Inverse Synthetic Aperture Radar.

HIGH-RESOLUTION RANGE PROFILE AND TARGET RECOGNITION 9

Range profile signature - Aspect angle effects -Target scatterers - Individual scatterers – Scatterer interference effects - Overview of range profiling process - Measurement of target signature - Target signature database - Signature conditioning and recognition algorithms - Applications of Non co -operative target recognition - Fixed wing aircraft with jet engines - Propeller driven aircraft - Helicopters - Ships - Surface based platforms - Airborne platforms - Land vehicles and people - Air breathing missile recognition techniques - Techniques for recognizing ballistic missiles.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Mark A.Richards, James A. Scheer, William A.Holm, “Principles of Modern Radar”, Scitech Publishers, 2012.
2. Mark A.Richards, “Fundamentals of Radar Signal Processing”, 2nd Edition, Mcgraw Hill, 2014.
3. Tait, P, “Introduction to Radar Target Recognition”, Institution of Engineering and Technology, London, 2009.
4. Chen, V.C. Tahmoush. D, Miceli. W.J, “Radar micro-Doppler signature”, Processing and Applications” IET Digital Library, 2014.
5. Chen, V.C., “The Micro-Doppler Effect in Radar”, Artech House, 2011.

23ES13E SEMICONDUCTOR DEVICE MODELING L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Explore the properties of MOS capacitors.
CO2: Analyze the various characteristics of MOSFET devices.
CO3: Describe the various CMOS design parameters and their impact on performance of the device.
CO4: Discuss the device level characteristics of BJT transistors.
CO5: Identify the suitable mathematical technique for simulation.

MOS CAPACITORS 9

Surface Potential: Accumulation, Depletion, and Inversion, Electrostatic Potential and Charge Distribution in Silicon, Capacitances in an MOS Structure, Polysilicon-Gate Work Function and Depletion Effects, MOS under Nonequilibrium and Gated Diodes, Charge in Silicon Dioxide and at the Silicon–OxideInterface, Effect of Interface Traps and Oxide Charge on Device Characteristics, High-Field Effects, Impact Ionization and Avalanche Breakdown, Band-to-Band Tunneling, Tunneling into and through Silicon Dioxide, Injection of Hot Carriers from Silicon into Silicon Dioxide, High-Field Effects in Gated Diodes, Dielectric Breakdown.

MOSFET DEVICES 9

Long-Channel MOSFETs, Drain-Current Model, MOSFET I–V Characteristics, Subthreshold Characteristics, Substrate Bias and Temperature Dependence of Threshold Voltage, MOSFET Channel Mobility, MOSFET Capacitances and Inversion-Layer Capacitance Effect, Short-Channel MOSFETs, Short-Channel Effect, Velocity Saturation and High-Field Transport Channel Length Modulation, Source–Drain Series Resistance, MOSFET Degradation and Breakdown at High Fields

CMOS DEVICE DESIGN 9

MOSFET Scaling, Constant-Field Scaling, Generalized Scaling, Nonscaling Effects, Threshold Voltage, Threshold-Voltage Requirement, Channel Profile Design, Nonuniform Doping, Quantum Effect on Threshold Voltage, Discrete Dopant Effects on Threshold Voltage, MOSFET Channel Length, Various Definitions of Channel Length, Extraction of the Effective Channel Length, Physical Meaning of Effective Channel Length, Extraction of Channel Length by C–V Measurements.

BIPOLAR DEVICES 9

n–p–n Transistors, Basic Operation of a Bipolar Transistor, Modifying the Simple Diode Theory for Describing Bipolar Transistors, Ideal Current–Voltage Characteristics, Collector Current, Base Current, Current Gains, Ideal IC–VCE Characteristics, Characteristics of a Typical n–p–n Transistor, Effect of Emitter and Base Series Resistances, Effect of Base–Collector Voltage on Collector Current, Collector Current Falloff at High Currents, Nonideal Base Current at Low Currents, Bipolar Device Models for Circuit and Time-Dependent Analyses Basic dc Model, Basic ac Model, Small-Signal Equivalent-Circuit Model, Emitter Diffusion Capacitance, Charge-Control Analysis, Breakdown Voltages, Common-Base Current Gain in the Presence of Base–Collector Junction Avalanche, Saturation Currents in a Transistor, Relation Between BVCEO and BVCBO.

MATHEMATICAL TECHNIQUES FOR DEVICE SIMULATIONS **9**

Poisson equation, continuity equation, drift-diffusion equation, Schrodinger equation, hydrodynamic equations, trap rate, finite difference solutions to these equations in 1D and 2D space, grid generation.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Yuan Taur and Tak H.Ning, "Fundamentals of Modern VLSI Devices", Cambridge University Press, 2016.
2. A.B. Bhattacharyya “Compact MOSFET Models for VLSI Design”, John Wiley & Sons Ltd, 2009.
3. Ansgar Jungel, “Transport Equations for Semiconductors”, Springer, 2009
4. Trond Ytterdal, Yuhua Cheng and Tor A. Fjeldly Wayne Wolf, “Device Modeling for Analog and RF CMOS Circuit Design”, John Wiley & Sons Ltd, 2004
5. Selberherr, S., “Analysis and Simulation of Semiconductor Devices”, Springer-Verlag., 1984
6. Behzad Razavi, “Fundamentals of Microelectronics” Wiley Student Edition, 2nd Edition, 2014
7. J P Collinge, C A Collinge, “Physics of Semiconductor devices” Springer, 2002.
8. S.M.Sze, Kwok.K. NG, “Physics of Semiconductor devices”, Springer, 2006.

23ES14E MODERN WIRELESS COMMUNICATIONS **L T P C**
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: Apply MIMO basics in recent wireless communication technologies. (K2)
CO 2: Comprehend significance and implementation of mm-Wave communication for the next generation wireless networks. (K2)
CO 3: Understand the concepts of Massive MIMO for new radio. (K2)
CO 4: Understand architecture and physical layer deployment for the fifth generation wireless communication systems. (K2)
CO 5: Understand physical layer concepts of fourth Generation wireless communication system. (K2)

MIMO BASICS **9**

Fundamentals of multiple antenna theory - Overview- MIMO Signal Model - Single User MIMO techniques – Multi-User MIMO techniques - Capacity of MIMO Communication Systems. MIMO schemes in LTE – Practical considerations.

MILLIMETER WAVE COMMUNICATIONS **9**

Spectrum and regulations – Channel propagation – Hardware technologies for mmW systems- Deployment scenarios- Architecture and Mobility - Beamforming - Physical layer techniques- Transmission schemes.

MASSIVE MIMO COMMUNICATION **9**

Multiple Base Station Antennas and Multiple Terminals - single-Cell System and Multi-Cell System, Capacity, Pilot design, Resource allocation and transceiver algorithms, Fundamentals of baseband and RF implementations, Channel models.

5G ARCHITECTURE AND RADIO ACCESS TECHNOLOGIES **9**

High level requirements for 5G Architecture - Functional architecture and 5G flexibility- Physical architecture and 5G deployment- Non orthogonal schemes for effective multiple access.

LTE and LTE ADVANCED **9**

Comparison of LTE (Release 8) and LTE Advanced (Release 10) – LTE downlink- LTE uplink-LTE Modulation schemes-Carrier aggregation-Throughput for LTE SISO link and LTE Advanced 8x 8 MIMO link-LTE Frame structure-Logical and Physical Channels.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Andreas F.Molisch, “Wireless Communications”, John Wiley & Sons Ltd, 2016.
2. Stefania Sesia, Issam Toufik, Matthew Baker, “LTE- The UMTS Long Term Evolution”, John Wiley & Sons Ltd, 2011.
3. Afif Osseiran, Jose F. Monserrat, Patrick Marsch, “5G Mobile and Wireless Communications Technology”, Cambridge University Press, 2016.
4. Simon Haykin , Michael Moher, David Koilpillai, “Modern Wireless Communication”, First Edition, Pearson Education 2013.
5. Jochen Schiller, “Mobile Communications”, Second Edition, Pearson Education 2012.
6. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.

WEB REFERENCE

1. http://download.ni.com/evaluation/rf/Introduction_to_LTE_Device_Testing.pdf

23ES15E SIGNAL INTEGRITY FOR HIGH-SPEED DESIGN **L T P C**
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Explore the signal propagation on transmission lines.
CO2: Analysis the different factors related to cross talk.
CO3: Understand the effect of switching pattern.
CO4: Understand concept of vias on multi conductor system.
CO5: Explore system power delivery and parametric analysis.

SIGNAL PROPAGATION ON TRANSMISSION LINES **9**

Issues on signal Integrity-Characteristic impedance-Propagation velocity-Propagation delay-Time delay-Reflection coefficient-Lattice diagrams-Microstrip and strip lines-Termination schemes – Layer stack up

CROSS TALK **9**

Near end cross talk-Far end cross talk-Coupling due to electric field-Coupling due to magnetic field – Inductance matrix for multi conductor system – Capacitance matrix for multi conductor system - Minimization of far end and near end cross talks

EFFECT OF SWITCHING PATTERN **9**

Pulse generation: Even and odd mode – Equivalent circuit for even and odd mode capacitance – Equivalent circuit for even and odd mode inductance – Characteristic impedance – Time delay – Problems – Coupling coefficient – Differential signaling – Terminations: Pi Termination and T termination – Dispersion – Lossy and loss less multi conductor transmission lines

VIAS FOR MULTI CONDUCTOR SYSTEM **9**

Layer connectivity using vias – Parasitic capacitance – Parasitic inductance – Rise time - Trace pitch – PCB tracks – Problems – Capacitance and Inductance of vias – Distortion – Connectors – Performance measure: Mutual inductance, Series inductance and parasitic capacitance – Measure of radiation – Way to reduce emissions

PARAMETRIC ANALYSIS **9**

Distribution of uniform voltage – Effect of power supply wiring on gates connected system – Supply and ground rail provisions – Inductance and bypass capacitance of power supply wiring – Trade off between range of frequency and noise – Problems – Power dissipation: Static and dynamic – Inter symbol interference (ISI) - Minimization of ISI – Issue on Clock skew-Fan in – Fan out – Gate delay – Wire delay-Noise margin

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Brain young, “Digital Signal Integrity: Modeling and Simulation with Interconnects and Packages”, Prentice Hall, 2008.
2. H.W.Johnson and M.Graham, High Speed Digital Design: A Handbook of Black Magic, Prentice Hall, 1993.
3. Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice Hall PTR, 2003.
4. S.Hall, G.Hall and J. McCall, High–Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices, Wiley –Inter science, 2000.
5. Eric Bogatin, Signal and Power Integrity Simplified, Prentice Hall PTR, 2nd Edition, 2010
6. Paul G.Huray “The Foundations of Signal Integrity” John Wiley & Sons, Inc., Publication, 2010
7. http://www.hottconsultants.com/outlines/ad-si.html
8. http://www.electrical-integrity.com/Links.html

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23ES16E MEMS and NEMS TECHNOLOGY **L T P C**
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Explain the material properties and the significance of MEMS and NEMS for industrial automation. (K2)
CO2: Demonstrate knowledge delivery on micromachining and micro fabrication. (K3)
CO3: Apply the fabrication mechanism for MEMS sensor and actuators. (K3)
CO4: Apply the concepts of MEMS and NEMS to models, simulate and process the sensors and actuators. .(K3)
CO5: Identify the MEMS applications. (K2)

INTRODUCTION TO MEMS and NEMS **9**

Overview of Micro electro mechanical systems and Nano Electro mechanical systems, devices and technologies, Laws of scaling- Survey of materials- Smart Sensors-Applications of MEMS and NEMS.

MICRO-MACHINING AND MICROFABRICATION TECHNIQUES **9**

Photolithography- Film deposition, Etching Processes- wafer bonding- Bulk micro machining, silicon surface micro machining- LIGA process.

MICRO SENSORS AND MICRO ACTUATORS **9**

Transduction mechanisms in different energy domain- Micromachined capacitive, Piezoelectric , piezoresistive and Electromechanical and thermal sensors/actuators and applications

NEMS TECHNOLOGY **9**

Atomic scale precision engineering- Nano Fabrication techniques - NEMS in measurement, sensing, actuation and systems design.

MEMS and NEMS APPLICATION **9**

Introduction to Micro/Nano Fluids and applications- Bio MEMS- Optical NEMS- Micro and Nano motors- Recent trends in MEMS and NEMS.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Tai-.Ran Hsu, "MEMS and Microsystems: design , manufacture, and Nanoscale" 2nd Edition, John Wiley & Sons, Inc., Hoboken, New Jersey, 2008
2. Chang Liu, "Foundations of MEMS", 2nd Edition, 2012.
3. Maluf, Nadim "An introduction to Micro Electro-mechanical Systems Engineering "AR Tech house, Boston 2nd Edition, 2004
4. Sabriesolomon "Sensors Handbook", Mc Graw Hill, 2nd Edition 2010.
5. Lyshevski, S.E. "Nano- and Micro-Electromechanical Systems: Fundamentals of Nano-and Micro engineering" 2nd Edition, CRC Press, 2005.

23ES17E HARDWARE - SOFTWARE CO-DESIGN OF EMBEDDED SYSTEM **L T P C**
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Understand the key concepts in hardware/software co- design (K2)
CO2: Understand the data flow implementation in software and hardware(K2)
CO3: Classify the fundamental building blocks of hardware/software co-design (K2)
CO4: Understand the concepts of interfacing schemes(K2)
CO5: Distinguish the various FPGA processors (K2)

NATURE OF HARDWARE AND SOFTWARE **9**

Hardware, Software, Definition of Hardware/Software Co-Design – Driving factors Platform design space – Application mapping – Dualism of Hardware design and software design – Concurrency and parallelism, Data flow modeling and Transformation – Data Flow Graph – Tokens, actors and queues, Firing rates, firing rules and Schedules – Synchronous data flow graph – control flow modeling – Adding time and resources – Transformations.

DATA FLOW IMPLEMENTATION IN SOFTWARE AND HARDWARE **9**

Software Implementation of Data Flow – Converting queues and actors into software, Dynamic Scheduler – Hardware Implementation of Data Flow – single rate SDF graphs into hardware, Pipelining – Analysis of control flow and data flow – construction of control and data flow graph – Translating C into hardware – Designing data path and controller.

DESIGN SPACE OF CUSTOM ARCHITECTURES **9**

Finite state machines with data path – FSMD design example, Limitations – Micro programmed Architecture – Micro programmed control, microinstruction encoding, Micro programmed data path, micro programmed machine – General purpose Embedded Core – RISC pipeline,

Program organization – SoC interfaces for custom hardware – Design Principles in SoC Architecture

HARDWARE/ SOFTWARE INTERFACES **9**

Principles of Hardware/software communication – synchronization schemes, communication constrained versus Computation constrained, Tight and Loose coupling - On-chip buses – Memory mapped interfaces – coprocessor interfaces – custom instruction interfaces – Coprocessor hardware interface – Data and control design, programmer's model.

APPLICATIONS **9**

Zynq processor-centric platforms-Scalable Processor Architecture, Trivium for 8-bit platforms – AES coprocessor, CORDIC coprocessor – algorithm and implementation

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Ralf Niemann, "Hardware/Software Co-Design for Data Flow Dominated Embedded Systems", Kluwer Academic Pub, 2010.
2. Jorgen Staunstrup, Wayne Wolf, "Hardware/Software Co-Design: Principles and Practice", Kluwer Academic Pub, 2013.
3. Giovanni De Micheli, Rolf Ernst Morgon, "Reading in Hardware/Software Co-Design" Kaufmann Publishers, 2002.
4. Patrick Schaumont, "A Practical Introduction to Hardware/Software Co-design", 2nd Edition, Springer, 2014.
5. Louise H. Crockett, "Embedded Processing with the ARM Cortex-A9 on the Xilinx Zynq-7000 All Programmable SoC" Strathclyde Academic Media,2014

23ES18E **EMBEDDED NETWORKING** **L T P C**
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Distinguish the wired and wireless network protocols
CO2: Design an application using CAN protocol for embedded networking
CO3: Understand the fundamentals of Ethernet.
CO4: Integrate networks using Ethernet.
CO5: Understand the basics of wireless sensor networks

COMMUNICATION PROTOCOLS **9**

Serial/Parallel Communication – Serial communication protocols -RS232 standard – RS485 – Synchronous Serial Protocols -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – PC Parallel port programming - PCI Bus protocol – UCI Bus protocol

USB AND CAN BUS **9**

USB bus – Introduction – Speed Identification on the bus – USB States – USB bus communication: Packets –Data flow types –Enumeration –Descriptors –PIC Microcontroller USB Interface – CAN Bus – Introduction - Basic Concepts & Definitions-Identifiers & Arbitration-Robustness & Flexibility-Message Formats-Error Handling -PIC microcontroller CAN Interface – A simple application with CAN.

ETHERNET BASICS **9**

Elements of a network – Inside Ethernet – Building a Network: Hardware options – Cables, Connections and network speed – Design choices: Selecting components –Ethernet Controllers – Using the internet in local and internet communications – Inside the Internet protocol.

EMBEDDED ETHERNET **9**

Exchanging messages using UDP and TCP – Serving web pages with Dynamic Data – Serving web pages that respond to user Input – Email for Embedded Systems – Using FTP.

EMBEDDED WIRELESS SENSOR NETWORKS **9**

Wireless sensor networks –Introduction to WSN-Challenges for WSNs - Characteristic requirements - Required mechanisms - Single-node architecture -Hardware components-Energy consumption of sensor nodes-Operating systems and execution environments-Some examples of sensor nodes.

L: 45; TOTAL: 45 PERIODS

REFERENCES

1. Frank Vahid, Tony Givargis, “Embedded Systems Design: A Unified Hardware/Software Introduction” - John & Wiley Publications, 2006
2. Jan Axelson, “Parallel Port Complete: Programming, interfacing and using the PCs parallel printer port” - Penram Publications, 1996.
3. Dogan Ibrahim, “Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F series” - Elsevier 2008.
4. Jan Axelson, “Embedded Ethernet and Internet Complete”, Penram publications, 2003.
5. Bhaskar Krishnamachari, Networking, Wireless Sensors - Cambridge press 2005.
6. Olaf Pfeiffer, Andrew Ayre and Christian Keydel, “Embedded Networking with CAN and CAN open”, Second Edition published by Copperhill Media Corporation, 2003.
7. Holgerkarl, Andreas Willig, “Protocols and architectures for wireless sensor networks”, John Wiley,2005

Estd : 1984

23AC01E **TECHNICAL REPORT WRITING**

L	T	P	C
2	0	0	0

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: Enhance the knowledge of the research objectives and research process
CO2: Develop the level of readability for formulating rationale and improve writing skills
CO3: Formulate suitable sentences and key words for the research paper
CO4: Develop the skill of chapterisation and research writing
CO5: Interpretation of data through various strategies
CO 6: Implementation of basic rules and methods of citation

INTRODUCTION TO RESEARCH **5**

Research – Writing Definitions – Framing Objectives – Research process - Formulating Research problem – Technical terms and extended definition - Breaking up long sentences--structuring paragraphs and sentences - being concise and removing redundancy avoiding ambiguity and vagueness.

IDENTIFICATION & COLLECTION OF SOURCES **5**

Preparing manuscript – Skimming and Scanning – Review of literature- Identifying the problem - writing problem statements – writing hypothesis- Formulating Rationale – Research Design - linking phrases – Observation and Interview method – Framing Questionnaire – Case study

WRITING AND DRAFTING ABSTRACT **5**

Processing and data analysis – Identifying threats and challenges to Good Research - key skills needed to write a title - writing abstracts writing key words and introduction- Introductory phrases - Clarity in imperative sentences instruction writing – useful phrases to draft a perfect paper

CHAPTERISATION **5**

Main divisions and Subdivisions – Paragraph writing - coherence - Highlighting the findings - Analyzing Data collection - hedging and criticizing sections - Topic sentence --Paraphrasing and framing key points – Suitable section wise headings

INTERPRETATION OF DATA **5**

Non-verbal interpretation – Interpretation of Data - Abbreviations – Symbols Tables – graphs – charts - deriving result – Phrases used to Compare and Contrast -result and discussion-- skills needed to write the conclusions – avoiding common mistakes.

BIBLIOGRAPHY **5**

Citation methods – Writing Foot note – End note - bibliography – citation rules Basic reference format - plagiarism – acknowledgement – IEEE Research format – Research review Research paper Publication

L: 30; TOTAL: 30 PERIODS

REFERENCES

1. Brent, Doug. Reading as Rhetorical Invention: Knowledge, Persuasion, and the Teaching of Research-based Writing. Urbana, National Council of Teachers of English, 1992.
2. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht, 2016
3. Robert A. Day and Barbara Gastel, How to Write and Publish a Scientific Paper‖, Cambridge University Press, 7th Edition, 2012
4. Thiel, David V. Research Methods for Engineers. United Kingdom, Cambridge University Press, 2014.

23AC02E **DISASTER MANAGEMENT** **L T P C**
2 0 0 0

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and manitarian response.

CO2: Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO3: Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO4. 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.

INTRODUCTION 4

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

REPERCUSSIONS OF DISASTERS AND HAZARDS 6

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.

DISASTER PRONE AREAS IN INDIA 6

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.

DISASTER PREPAREDNESS AND MANAGEMENT 6

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.

RISK ASSESSMENT AND DISASTER MITIGATION 8

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

L: 30; TOTAL: 30 PERIODS

REFERENCES

1. Singhal J.P. —Disaster Managementǁ, Laxmi Publications, ISBN-10: 9380386427 ISBN-13: 978-9380386423, 2010
2. Tushar Bhattacharya, —Disaster Science and Managementǁ, McGraw Hill India Education Pvt. Ltd., ISBN-10: 1259007367, ISBN-13: 978-125900736, 2012.
3. Gupta Anil K, Sreeja S. Nair, "Environmental Knowledge for Disaster Risk Management", NIDM, New Delhi, 2011.
4. Kapur Anu, "Vulnerable India: A Geographical Study of Disasters", IIAS and Sage Publishers, New Delhi, 2010.

5. National Disaster Management Plan, 2018, https://ndma.gov.in/images/pdf/NDMP-2018-Revised-Draft-1-2018OCT16-A.pdf
6. National Disaster Management Authority, Government of India, 2018, https://ndma.gov.in/images/pdf/Draft-Guidelines-thunderstorm-final.pdf

23AC03E SANSKRIT FOR TECHNICAL KNOWLEDGE L T P C
2 0 0 0

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: Learn the Sanskrit sources of technical knowledge
CO2: Drawing their attention to a different dimension of Sanskrit literary tradition
CO3: Create awareness of the contemporary relevance of the Sanskrit sources of traditional wisdom

INTRODUCTION 7

Scope and meaning of study of technical literature in Sanskrit. Different disciplines-interdisciplinary approach-dimensions-contemporary relevance- important works in this direction-scientific methodology in ancient India.

AYURVEDA 7

Beginnings of Ayurveda in Atharvaveda-Ayurvedic literature-basic principles of Ayurveda-Pancabhutasiddhanta-Tridosasiddhanta-eight anga-s of Ayurveda- Rasacikitsa-contribution of Kerala to Ayurveda

ASTRONOMY AND MATHEMATICS 8

Major texts in Vedic and classical period-Vedangajyotisa-Sulbasutra-s-Aryabhatiya- Aryabhata's contribution-Varahamihira-Brahmagupta-Lalla-etc. Suryasiddhanta- Kerala school Parahita and drk systems-Later astronomical works commentaries.

VASTUSASTRA AND ARTHASASTRA 8

Principles of Vastusastra-Basic texts-Vastuvidya and Ecology-Iconography and sculpture-Kerala tradition of Vastusastra. Arthasastra, a historical and sociaological perspective-structure and contents of the text-emphasis to aspects of agriculture and architecture.

L: 30; TOTAL: 30 PERIODS

REFERENCES

1. Ramakrishna Mission Institute ,"Cultural Heritage of India", (Vol. i and iii), Calcutta, 2010
2. Dr.P.C. Muraleemadhavan and Dr.N.K.Sundareswaran," Sanskrit in Technological Age,(Ed.)", New Bharatiya Book Corporation, Delhi, 2006
3. https://sanskritdocuments.org/articles/ScienceTechSanskritAncientIndiaMGPrasad.pdf
4. http://www.vedanta.gr/wp-content/uploads/2012/03/3_GlossaryOfCommonSanskrit Terms.pdf

23AC04E VALUE EDUCATION L T P C
2 0 0 0

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: Understand the need of values and its classification in contemporary society
CO2: Become aware of role of education in building value as dynamic social reality.

CO3: Know the importance of value education towards personal, national and global development.

10

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.
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.

10

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.

10

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.

L: 30; TOTAL: 30 PERIODS

REFERENCES

1. Sharma, S.P., "Moral and Value Education: Principles and Practices", Kanishka publishers, 2013.
2. Kiruba Charles & V.Arul Selvi.," Value Education", Neelkamal Publications, New Delhi, 2012.
3. Passi, B.K. and Singh, P.,"Value Education", National Psychological Corporation, Agra. 2004.
4. http://cbseportal.com/exam/e-books/download-free-ncert-e-book-education-for-values-in-school-a-framework/
5. http://cbseacademic.in/web_material/ValueEdu/Value%20Education%20Kits.pdf

23AC05E CONSTITUTION OF INDIA L T P C
2 0 0 0

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

CO2: 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.

CO3: 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.

HISTORY AND PHILOSOPHY OF INDIAN CONSTITUTION 6

History-Drafting Committee, (Composition & Working). - Preamble- Salient Features.

CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES 6

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.

ORGANS OF GOVERNANCE **6**

Parliament- Composition-Qualifications and Disqualifications- Powers and Functions- Executive-President-Governor-Council of Ministers- Judiciary- Appointment and Transfer of Judges-Qualifications-Powers and Functions**.**

LOCAL ADMINISTRATION **6**

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.

ELECTION COMMISSION **6**

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.

L: 30; TOTAL: 30 PERIODS

REFERENCES

1. Subhash .C, kashyap "Our Constitution", 5th Edition, 2017
2. www.ieagreements.org/IEA-Grad-Attr-Prof-Competencies.pdf
3. The Constitution of India, 1950 (Bare Act), Government Publication.
4. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
5. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
6. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

23AC06E **PEDAGOGY STUDIES** **L T P C**
2 0 0 0

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: Describe the pedagogical practices used by teachers in formal and informal classrooms

CO2: Understand the effectiveness of these pedagogical practices, in what conditions, and with what population of learners

CO3: Analyze how teacher education (curriculum and practicum) and the school curriculum with guidance materials support effective pedagogy

INTRODUCTION AND METHODOLOGY **8**

Aims and rationale, Policy background, Conceptual framework and terminology-Theories of learning, Curriculum, Teacher education.Conceptual framework, Research questions**.** Overview of methodology and Searching. Thematic overview- Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries- Curriculum- Teacher education.

EFFECTIVENESS OF PEDAGOGICAL PRACTICES **8**

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 for effective pedagogical Practices- Pedagogic theory and pedagogical approaches- Teachers attitudes and beliefs and Pedagogic strategies.

PROFESSIONAL DEVELOPMENT **7**

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.

RESEARCH GAPS AND FUTURE DIRECTIONS **7**

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

L: 30; TOTAL: 30 PERIODS

REFERENCES

1. Dr.S.K.Bhatia and Dr.Sonia Jindal, “A Text Book of Curriculum, Pedagogy and Evaluation”, Paragon International Publications, 2016.
2. Ackers J, Hardman F Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261, 2001.
3. Agrawal M, "Curricular reform in schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361-379, 2004.
4. Akyeampong K, "Teacher training in Ghana - does it count?", Multi-site teacher education research project (MUSTER) country report 1. London: DFID, 2003.
5. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?", International Journal Educational Development, 33 (3): 272–282,2013.
6. Alexander RJ,"Culture and pedagogy: International comparisons in primary education", Oxford and Boston: Blackwell, 2001.
7. Chavan M, "Read India: A mass scale, rapid, ‘learning to read’", campaign, 2003.
8. www.pratham.org/images/resource%20working%20paper%202.pdf.

23AC07E **STRESS MANAGEMENT BY YOGA** **L T P C**
2 0 0 0

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: achieve overall health of body and mind

CO2: overcome stress

INTRODUCTION **10**

Introduction to Stress-Concept of Stress-Solutions through Mandukya karika - Relaxation and stimulation combined as the core for stress management-Practice of Stimulation and relaxation.

ASAN AND PRANAYAM **10**

Definitions of Eight parts of yoga. (Ashtanga)-Various yoga poses and their benefits for mind & body-Regularization of breathing techniques and its effects-Types of pranayam.

YOGA AND STRESS MANAGEMENT **10**

Concepts and Techniques of Stress Management in Ashtanga Yoga of Patanjali - specific practices for stress management-breathe awareness.

L: 30; TOTAL: 30 PERIODS

REFERENCES

1. Swami Vivekananda, Advaita Ashrama ,"Rajayoga or conquering the Internal Nature", 2016.
2. K.N.Udupa**, "**Stress and Its Management by Yoga", Edited by R.C.Prasad, Motilal Banarashidass Publishers, Delhi, 2010.
3. Lisa Shea,"Yoga for Stress Relief and Forgiveness", Kindle Edition, 2015.
4. BKS Iyengar, "Yoga: The path to Holstic Health", DK Publication, 2019
5. https://www.longdom.org/open-access/stress-and-yoga-2157-7595.1000109.pdf

23AC08E	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L T P C 2 0 0 0

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: learn to achieve the highest goal happily

CO2: become a person with stable mind, pleasing personality and determination (K1)

CO3: awaken wisdom in students

INTRODUCTION TO PERSONALITY DEVELOPMENT **10**

The concept of personality - Dimensions of personality – Theories of Freud & Erickson- Significance of personality development. The concept of success and failure: What is success? - Hurdles in achieving success - Overcoming hurdles - Factors responsible for success – What is failure - Causes of failure-SWOT analysis.

LIFE ENLIGHTENMENT SKILLS **10**

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).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.

SHRIMAD BHAGWAD GEETA STATEMENTS **10**

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, Chapter3 Verses 36, 37, 42, Chapter4 Verses 18, 38,39, Chapter18 Verses 37,38,63

L: 30; TOTAL: 30 PERIODS

REFERENCES

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