MAHATMA GANDHI MISSION`S

JAWAHARLAL NEHRU ENGINEERING COLLEGE

AURANGABAD.

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION

Curriculum for

M.Tech. in VLSI & Embedded System (VLSI & ES)

w.e.f.
Academic Year
2020-21

Vision Statement of Institute

To create self-reliant, continuous learner and competent technocrats imbued with human values.

Mission Statements of Institute

1. Imparting quality technical education to the students through participative teaching –learning process.
2. Developing competence amongst the students through academic learning and practical experimentation.
3. Inculcating social mindset and human values amongst thestudents.

Vision Statement of Department

To develop GREAT technocrats and to establish centre of excellence in the field of Electronics and Telecommunications

- **G**lobal technocrats with human values
- **R**esearch and lifelong learning attitude
- **E**xcellent ability to tackle challenges
- **A**wareness of the needs of society
- **T**echnical expertise

Mission Statement of Department

- To provide good technical education and enhance technical competency by providing good infrastructure, resources, effective teaching learning process and competent, caring and committed faculty.
- To provide various platforms to students for cultivating professional attitude and ethical values.
- Creating a strong foundation among students which will enable them to pursue their career choi

Program Educational Objectives (PEOs)

Graduates will be prepared

1. To cultivate the skills & attitude required to pursue career choices in Electronics and Telecommunication, allied fields and be able to contribute to the advancement of knowledge.
2. For deep insight in Electronics and Telecommunication concepts, mathematical, scientific and multidisciplinary engineering fundamentals required to solve engineering problems and pursue higher studies.
3. With good scientific and engineering knowledge in the field of Electronics and Telecommunication so as to comprehend, analyze, design and develop products and solutions for the real-life problems.
4. To exhibit professional attitude, effective communication skills, leadership roles, project management and an ability to relate engineering issues to broader social context
5. To continue professional and personal development with awareness of excellence and the life-long learning.

Program Specific Outcomes (PSOs)

1. Comprehend, analyze, design and implement electronic circuits and applications.
2. Apply knowledge in the field of Embedded and VLSI technology.
3. Apply knowledge in the field of image processing and telecommunications.

Program Outcomes (POs)

PO No.	Program Outcome Description
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design / Development of solution: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4	Conduct investigation of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	The engineer & society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	Environment & sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual & team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Project management & finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Lifelong learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Semester I

Subject Code	Subject	Teaching scheme			Credits	Examination scheme				
						Theory		CA	PR/ OR	Total
		L	T	P		ESM	MSE			
20PET101D	Advanced Digital System Design	3	0	0	3	60	20	20	--	100
20PET102D	Microcontrollers and Digital Signal Processors	3	0	0	3	60	20	20	--	100
	Elective I	3	0	0	3	60	20	20	--	100
20PET104EA	Digital Signal and Image Processing									
20PET104EB	Programming Languages forEmbedded Software									
20PET104EC	CPLD and FPGA Architecture and Application									
20PET105EA	**Elective II**	3	0	0	3	60	20	20	--	100
	Embedded Networking									
20PET105EB	System Design with Embedded Linux									
20PET105EC	Robotics and Machine Vision									
20PET106L	PG Lab (VLSI) Laboratory	0	0	4	2	--	--	25	25	50
20PET107S	Seminar	0	0	4	2	--	--	25	25	50
20PET103B	Research Methodology	2	0	0	2	60	20	20	--	100
20PET108H	Audit course 1	2	0	0	0	--	--	50	--	Audit
	Total	16	0	8	18	300	100	200	50	600

Semester II

Subject Code	Subject	Teaching scheme			Credits	Examination scheme				
						Theory		CA	PR/ OR	Total
		L	T	P		ESM	MSE			
20PET201D	Digital CMOS VLSI Design	3	0	0	3	60	20	20	--	100
20PET202D	Analog CMOS VLSI Design	3	0	0	3	60	20	20	--	100
20PET204EA	**Elective III**	3	0	0	3	60	20	20	--	100
	Memory Technologies									
20PET204EB	ARM Controllers									
20PET204EC	Low power VLSI Design									
	Elective IV	3	0	0	3	60	20	20	--	100
20PET205EA	Communication Buses and Interfaces									
20PET205EB	Network Security and Cryptography									
20PET205EB	Embedded Real Time Operating System									
20PET206L	PG Lab (Embedded Laboratory)	0	0	4	2	--	--	25	25	50
20PET207P	Mini Project	0	0	4	2	--	--	25	25	50
20PET203B	Internet of Things	2	0	0	2	60	20	20	--	100
20PET208H	Audit course 2	2	0	0	0	--	--	50	--	Audit
	Total	16	0	8	18	300	100	200	50	600

Semester III

Subject Code	Subject	Teaching scheme			Credits	Examination scheme				
						Theory		CA	PR/ OR	Total
		L	T	P		ESM	MSE			
20PET302MA 20PET302MB	Project Management / Intellectual Property Rights (Self Study)#	0	0	0	2	--	--	50	50	100
20PET301P	Dissertation Phase – I	0	0	20	10	--	--	50	50	100
	Total	0	0	20	12	00	00	100	100	200

Student has to choose this course either from NPTEL/MOOC pool and submission of course completion certificate is mandatory.

Semester IV

Subject Code	Subject	Teaching scheme			Credits	Examination scheme				
						Theory		CA	PR/ OR	Total
		L	T	P		ESM	MSE			
20PET401P	Dissertation Phase – II	0	0	32	16	--	--	100	100	200
	Total	0	0	32	16	00	00	100	100	200
	GRAND TOTAL	**32**	**00**	**68**	**64**	**600**	**200**	**600**	**300**	**1600**

Audit courses 1 & 2 (20PET108H and 20PET208H)

1. Value Education
2. Constitution of India

Semester-I

Course Code: 20PET101D	***Course Title***	***Credits:03***
Teaching Scheme	**Advanced Digital system *Design***	****Evaluation Scheme***
Theory : 03Hrs/week		*Continuous Assessment: 20*
Tutorial:--		*Midsem Exam: 20*
		Endsem: 60

Course Objectives	**1.**To prepare students for the design of practical digital hardware systems using VHDL. **2.**To introduce students to the fundamentals of combination logic design and then to sequential circuits (both synchronous and asynchronous). **3.** To provide opportunities to synthesize the designs (using both schematic capture and VHDL) for implementation in FPGAs
Course Outcomes	**CO1** Learner will be able to design combinational and synchronous asynchronous sequential circuits. **CO2** Learner will be able to design with PLDs **CO3** Learner will be able to express different aspects VHDL **CO4** Learner will be able to realize Digital circuits using HDL and get the knowledge of FPGA
Pre-requisites	**Basic knowledge of Digital Logic Design.**
Course Type	Program Core Course
Course Contents	**UNIT I** Introduction to Digital Design Combinational Circuit Design, Synchronous Sequential Circuit Design - Mealy and Moore model, State machine design, Synchronous sequential circuit Design using ASM, Analysis of Synchronous sequential circuit, State equivalence, State Assignment and Reduction. **UNIT II** FSM, Analysis of Asynchronous Sequential Circuit, flow table reduction, races, stateassignment, Hazards, Clock synchronization **UNIT III** Designing with PLDs – Overview of PLDs – ROMs, EPROMs – PLA – PAL - Gate Arrays – CPLDs and FPGAs, Designing with ROMs - Programmable Logic Arrays - Programmable Array logic, PAL series 16 & 22 – PAL22V10 - Design examples. **UNIT IV** Other PLDs-Generic Array Logic, ASCI, Types of ASIC, Design Flow, Memory of PLD, Artix 7 Layout Design and Tools: Transistor structures, Wires and Vias, Scalable Design rules, Layout Design tools. **UNIT V** VHDL Basics – Introduction to HDL –– Basic language elements – Entity – Architecture – Configurations – Subprograms– Test Bench – Advanced Features – Model simulation **UNIT VI** Realization of combinational and sequential circuits using HDL – Registers – Flip flops – counters – Shift registers –Multiplexers –Introduction to Synthesis and Synthesis Issues. Floor Planning: Floor planning methods, Global Interconnect, Floor Plan Design, Off-chip connections. z

Text Books:

1. Stephen Brown, ZvonkoVranesic, Fundamental of digital logic design with VHDL.
2. Douglas Pueknell& Kamran Eshraghian, Basic VLSI Design, Third Edition, PHI.
3. VLSI Design Black Book, Prasad Wiley Publications.
4. Parag K. Lala, "Digital System Design using programmable Logic Devices", Prentice Hall, NJ, 1994
5. Geoff Bestock, "FPGAs and programmable LSI; A Designers Handbook", Butterworth Heinemann, 1996

Reference Books:

1. M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 1997 J. Rabaey, Digital Integrated Circuits: A Design Perspective, Second Edition Prentice Hall India, 2003.
2. Jan Bhasker, VHDL PRIMER, Third Edition, PHI.
3. Xilinx FPGA /CPLD Data Book.
4. A.Pucknell, Kamran Eshraghian, “BASIC VLSI Design”, Third Edition, Prentice Hall of India, 2007.

E-sources:

1. VLSI Design Overview www.xilinx.com
2. Artix 7 Boardnexyas kits www.digilentinc.com
3. VLSI Design using Verilog and Hardware course www.udemy.com
4. Expanded FPGA training course www.coursera.org

Semester-I

Course Code: 20PET102D	***Course Title***	***Credits:03***
Teaching Scheme	***Microcontrollers and Digital Signal Processors***	****Evaluation Scheme***
Theory : 03Hrs/week		*CA1: 20 (Test)*
Tutorial: ----------		*CA2: 20 (Mid Sem)*
		End Sem: 60

Course Objectives	1. To introduce students to different microcontroller systems and to study their construction,characteristics. 2. To introduce students to different digital signal processor devices.
Course Outcomes	At the end of this course students will demonstrate the following skills: - 1. Select appropriate microcontroller device for various applications. 2. Select appropriate processor device for specific applications. 3. Analyze processor devices.
Pre-requisites	Basic processor.
Course Type	Core Course
Course Contents	**Unit 1:** **ARM Cortex-M3 processor:** Applications, Programming model – Registers, Operationmodes, 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, Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, FaultExceptions, Supervisor and Pendable 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 serialinterfaces, 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

Text Books:

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

Reference Books:

1. Steve furber, "ARM System-on-Chip Architecture", Pearson Education
2. Frank Vahid and Tony Givargis, "Embedded System Design", Wiley
3. Technical references and user manuals on www.arm.com, NXP Semiconductor www.nxp.com and Texas Instruments www.ti.com

Semester-I

Course Code: 20PET104EA	***Course Title***	***Credits:03***
Teaching Scheme	***Digital Signal and Image Processing***	****Evaluation Scheme***
Theory : 03Hrs/week		*CA1: 20 (Test)*
Tutorial: ----------		*CA2: 20 (Mid Sem)*
		End Sem: 60

Course Objectives	1. To introduce students to different digital signals and to study their construction,characteristics. 2. To introduce students to different image system.
Course Outcomes	At the end of this course students will demonstrate the following skills: - 1. Select appropriate Image system device for various applications. 2. Select appropriate digital signal device for specific applications. 3. Analyze digital signals.
Pre-requisites	Digital signals.
Course Type	Program Elective 1
Course Contents	**Unit 1:** Review of Discrete Time signals and systems, Characterization in time and Z and Fourier – domain, Fast Fourier Transform algorithms – In-place computations, Butterfly computations, bit reversal's. **Unit 2:** Digital Filter design: FIR - Windowing and Frequency Sampling, IIR – Impulseinvariance, bilinear Transformation. **Unit 3:** Fixed point implementation of filters – challenges and techniques. **Unit 4:** Digital Image Acquisition, Enhancement, Restoration. Digital Image Coding and Compression – JPEG and JPEG 2000. **Unit 5:**

	Color Image processing – Handling multiple planes, computational challenges. **Unit 6:** VLSI architectures for implementation of Image Processing algorithms, Pipelining.

Text Books:

1. Gonzalez and Woods, Digital Image Processing, Pearson Education
2. J.G. Proakis, Manolakis "Digital Signal Processing", Pearson, 4th Edition

Reference Books:

1. A. K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall
2. Vasudev Bhaskaran- Image and video Coding Standards- Cluwer Academic

Semester-I

Course Code: 20PET104EB	***Course Title***	***Credits:03***
Teaching Scheme	***Programming Languages for Embedded Software***	****Evaluation Scheme***
Theory : 03Hrs/week		*CA1: 20 (Test)*
Tutorial: ----------		*CA2: 20 (Mid Sem)*
		End Sem: 60

Course Objectives	1. To introduce students to embedded languages and to study their characteristics. 2. To introduce students to different embedded software
Course Outcomes	At the end of this course students will demonstrate the following skills: - 1. Select appropriate programming language for various applications. 2. Select appropriate embedded software for specific applications. 3. Analyze embedded programs.
Pre-requisites	microcontrollers.
Course Type	Program Elective 1
Course Contents	**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 deleteoperators, 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.

Text Books:

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

Reference Books:

1.Robert Sedgewick, "Algorithms in C++", Addison Wesley Publishing Company, 1999

Semester-I

Course Code: 20PET104EC	***Course Title***	***Credits:03***
Teaching Scheme	**CPLD AND FPGA ARCHITECURES AND APPLICATIONS**	****Evaluation Scheme***
Theory : 03Hrs/week		*Continuous Assessment: 20*
Tutorial:--		*Midsem Exam: 20*
		Endsem: 60

Course Objectives	To introduce CPLD and FPGA logic devices and their design applications
Course Outcomes	CO1.Student will be able to CPLD and FPGA Architectures. CO2Student will be able to analyse System level Design CO3Student will be familiar with Anti-Fuse Programmed FPGAs CO4Student will able to apply knowledge of this subject for various design applications
Pre-requisites	**Basic knowledge of CPLD and FPGA.**
Course Type	Program Specific Elective -I
Course Contents	**UNIT I** Introduction to Asics, CMOS Logic and ASIC Library Design Types of ASICs - Design Flow - CMOS transistors, CMOS design rules - Combinational Logic Cell - Sequential logic cell - Data path logic cell - transistors as resistors - transistor parasitic capacitance - Logical effort **UNIT II** Programmable Logic Cells and I/O Cells Digital clock Managers-Clock management- Regional clocks-Block RAM – Distributed RAM Configurable Logic Blocks-LUT based structures – Phase locked loops-Select I/O resources –Anti fuse - static RAM - EPROM and EEPROM technology. – Architecture of Xilinx Cool Runner XCR3064XL CPLD, CPLD Implementation of a Parallel Adder with Accumulation. **UNIT III** Field Programmable Gate Arrays: Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, and Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, Applications of FPGAs.

	UNIT IV SRAM Programmable FPGAs: Introduction, Programming Technology, Device Architecture, The Xilinx XC4000 and Artix7Architectures, Zed Board. **UNIT V** Anti-Fuse Programmed FPGAs: Introduction, Programming Technology, Device Architecture, The Actel ACT1 Architectures. **UNIT VI** Design Applications: General Design Issues, Counter Examples, A Fast Video Controller, A Position Tracker for a Robot Manipulator, A Fast DMA Controller, Designing Counters with ACT devices, Designing Adders and Accumulators with the ACT Architecture.

Textbooks / References:

6. Stephen Brown, ZvonkoVranesic, Fundamental of digital logic design with VHDL.
7. Wayne Wolf, FPGA based System Design - Prentice Hall Modern Semiconductor Design Series.
8. Stephen M. Trimberger, Field Programmable Gate Array Technology - Springer International Edition.
9. Charles H. Roth Jr, Lizy Kurian John, Digital Systems Design - Cengage Learning.
   John V. Oldfield, Richard C. Dorf, Field Programmable Gate Arrays - Wiley India.
10. Pak K. Chan/Samiha Mourad, Digital Design Using Field Programmable Gate Arrays - Pearson Low Price Edition.
11. Ian Grout, Digital Systems Design with FPGAs and CPLDs - Elsevier, Newnes.
12. Xilinx FPGA /CPLD Data Book.

E-sources:

5. VLSI Design Overview www.xilinx.com
6. Zed and Artix 7 Boardnexyas kits www.digilentinc.com
7. VLSI Design using Verilog and Hardware course www.udemy.com
8. Expanded FPGA training course www.coursera.org

Semester-I

Course Code: 20PET105EA	***Course Title***	***Credits:03***
Teaching Scheme	***Embedded Networking***	****Evaluation Scheme***
Theory : 03Hrs/week		*CA1: 20 (Test)*
Tutorial: ----------		*CA2: 20 (Mid Sem)*
		End Sem: 60

Course Objectives	1. To introduce students to networking signals and to study their characteristics. 2. To introduce students to different embedded system.
Course Outcomes	At the end of this course students will demonstrate the following skills: - 1. Select appropriate embedded system device for various applications. 2. Select appropriate embeddeddevice for specific applications. 3. Analyze networking signals.
Pre-requisites	microprocessor.
Course	Program Elective 2

Type	
Course Contents	**Unit 1:** Overview of Parallel Processing and Pipelining, Performance analysis, Scalability **Unit 2:** Principles and implementation of Pipelining, Classification of pipelining processors, Advanced pipelining techniques, Software pipelining **Unit 3:** **VLIW processors** Case study: Superscalar Architecture- Pentium, Intel Itanium Processor, Ultra SPARC, MIPS on FPGA, Vector and Array Processor, FFT Multiprocessor Architecture **Unit 4:** Multithreaded Architecture, Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions **Unit 5:** **Parallel Programming Techniques:** Message passing program development, Synchronous and asynchronous message passing, Shared Memory Programming, Data Parallel Programming, Parallel Software Issues **Unit 6:** Operating systems for multiprocessors systems Customizing applications on parallel processing platforms

Text Books:

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

Reference Books:

1. Kai Hwang, "Advanced Computer Architecture", TMH

Semester-I

Course Code: 20PET105EB	***Course Title***	***Credits:03***
Teaching Scheme	***System Design with Embedded Linux***	****Evaluation Scheme***
Theory : 03Hrs/week		*CA1: 20 (Test)*
Tutorial: ----------		*CA2: 20 (Mid Sem)*
		End Sem: 60

Course Objectives	1. To introduce students to system design and to study their characteristics. 2. To introduce students to different embedded linux system.
Course Outcomes	At the end of this course students will demonstrate the following skills: - 1. Select appropriate embedded system device for various applications. 2. Select appropriate embeddeddevice for specific applications. 3. Analyzelinux signals.
Pre-requisites	microprocessor.
Course Type	Program Elective 2
Course Contents	**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, I 2 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

Text Books:

1. Karim Yaghmour, "Building Embededd Linux Systems", O'Reilly & Associates
2. P Raghvan, Amol Lad, SriramNeelakandan, "Embedded Linux System Design and Development", Auerbach Publications

Reference Books:

1. Christopher Hallinan, "Embedded Linux Primer: A Practical Real World Approach", Prentice Hall, 2 nd Edition, 2010.

Semester-I

Course Code: 20PET105EC	***Course Title***	***Credits:03***
Teaching Scheme	***Robotics and Machine Vision***	****Evaluation Scheme***
Theory : 03Hrs/week		*CA1: 20 (Test)*
Tutorial: ----------		*CA2: 20 (Mid Sem)*
		End Sem: 60

Course Objectives	1. To introduce students to robotic system design. 2. To introduce students to different machine vision system.
Course Outcomes	At the end of this course students will demonstrate the following skills: - 1. Select appropriate robotic system device for various applications. 2. Select appropriate machinedevice for specific applications. 3. Analyze robotics signals.
Pre-requisites	Machines, control system.
Course Type	Program Elective 2
Course Contents	**Unit 1** **Introduction:** Basic Concepts such as Definition, three laws, DOF, Misunderstood devices etc., Elements of Robotic Systems i.e. Robot anatomy, Classification, Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device, etc. Automation - Concept, Need, Automation in Production System, Principles and Strategies of Automation, Basic Elements of anAutomated System, Advanced Automation Functions, Levels of Automations, introduction toautomation productivity. **Unit 2** **Robot Grippers:** Types of Grippers , Design aspect for gripper, Force analysis for various basic gripper system.Sensors for Robots:- Characteristics of sensing devices, Selections of sensors,

	Classification andapplications of sensors. Types of Sensors, Need for sensors and vision system in the working andcontrol of a robot. **Unit 3** **Drives and control systems:** Types of Drives, Actuators and its selection while designing a robot system. Types of transmissionsystems,Control Systems -Types of Controllers, Introduction to closed loop controlControl Technologies in Automation:- Industrial Control Systems, Process Industries VersesDiscrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and itsForms. Control System Components such as Sensors, Actuators and others. **Unit 4** **Kinematics:** Transformation matrices and their arithmetic, link and joint description, Denavit – Hartenbergparameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematicscalibration, inverse kinematics, solvability, algebraic and geometrical methods. Velocities andStatic forces in manipulators:- Jacobians, singularities, static forces, Jacobian in force domain.Dynamics:- Introduction to Dynamics , Trajectory generations **Unit 5** **Machine Vision System:** Vision System Devices, Image acquisition, Masking, Sampling and quantisation, Image Processing Techniques , Noise reduction methods, Edge detection, Segmentation. Robot Programming :- Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Introduction to various types such as RAIL and VAL II etc, Features oftype and development of languages for recent robot systems. **Unit 6** **Modeling and Simulation for manufacturing Plant Automation:** Introduction, need for system Modeling, Building Mathematical Model of a manufacturing Plant,Modern Tools- Artificial neural networks in manufacturing automation, AI in manufacturing,Fuzzy decision and control, robots and application of robots for automation. Artificial Intelligence:- Introduction to Artificial Intelligence, AI techniques, Need and applicationof AI. Other Topics in Robotics:- Socio-Economic aspect of robotisation. Economical aspects forrobot design, Safety for robot and associated mass, New Trends & recent updates in robotics

Text Books:

1. John J. Craig, Introduction to Robotics (Mechanics and Control), Addison-Wesley, 2 nd Edition, 04

Reference Books:

1. Mikell P. Groover et. Al., Industrial Robotics: Technology, Programming and Applications, McGraw – Hill International, 1986.

Semester-I

PG LAB-I (20PET106L**)**

Weekly Teaching Hours TH: -- Practical: 02

Scheme of Marking TH: -- IA: 25 PR/OR: 25 Total: 50

Practical of the Lab - The lab work shall consistof hands on experiments on the VLSI software and hardware platforms related to the syllabus.

Semester-I

Course Code: 20PET107S	**Course Title**	**Credits:02**
Execution Scheme	***SEMINAR***	***Evaluation Scheme**
Practical :04Hrs/week	**SEMINAR**	**CA: 25 Marks** **Practical Exam: 25 Marks**

Course Objectives	1. To make the students aware about speaking, delivery and presentation skills
Course Outcomes	Upon completing this lab students must be able to:- 1.Deliver seminar presentation effectively.
Course Contents	The seminar shall be on the state of the art in the area of the wireless communication and computing and of student's choice approved by an authority. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work duly signed by the concerned guide and head of the Department/Institute.

Semester-I

Course Code: 20PET103B	***Course Title***	***Credits:02***
Teaching Scheme	***Research Methodology***	***Evaluation Scheme**
Theory : 02Hrs/week		*CA1: 20 (Test)*
Tutorial: ----------		*CA2: 20 (Mid Sem)*
		End Sem: 60

Course Objectives	1. To introduce students to research methods. 2. To introduce students to research software
Course Outcomes	At the end of this course students will demonstrate the following skills: - 1. Select appropriate programming language for research. 2. Select appropriate research software. 3. Analyze research programs.
Pre-requisites	UG level Project experience
Course Type	1.2
Course Contents	**UNIT-1** Introduction: Defining research, Motivation and Course Objectives:, Types of research Meaning of Research, Course Objectives: of Research, Motivation in Research, Types of Research **UNIT-2** Research Formulation: Formulating The research Problem, Literature Review, Development of Working Hypothesis **UNIT-3** Research Design: Important Concept in Research Design, Research Life Cycle, Developing Research Plan **UNIT-4** Overview of Modeling and Simulation: Classification of models, Development of Models, Experimentation, Simulation.

	UNIT-5 Statistical Aspects: Methods of Data Collection, Sampling Methods, Statistical analysis, Hypothesis testing. **UNIT-6** Research Report: Research Ethics, Plagiarism, Research Proposal, Report Writing and Writing Research Papers.

Text Books:

1. J.P. Holman., Experimental Methods for Engineers

Reference Books:

1.C.R. Kothari, Research Methodology, Methods & Techniques

Semester-II

Course Code: 20PET201D	***Course Title***	***Credits:03***
Teaching Scheme	**Digital CMOS VLSI Design**	****Evaluation Scheme***
Theory : 03Hrs/week		*Continuous Assessment: 20*
Tutorial:--		*Midsem Exam: 20*
		Endsem: 60

Course Objectives	1 To introduce MOS technology and its layout design rules 2 To provide basic knowledge sequential and combinational logic design 2.To introduce modelling /design of different circuits using CMOS
Course Outcomes	**CO1**students will be able to express technologies such as MOS, BiCMOS **CO2**students will be able to design basic gates and their alternative circuits **CO3**students will be able to design and simulate combinational logic designs CO4 Learner will be able to design basic gates and their alternative circuits CO5 Learner will be able to validate and test the design
Pre-requisites	**Basic knowledge of MOS, CMOS, Linear Circuits.**
Course Type	Program Core Course
Course Contents	**UNIT I** Introduction to MOSFETs: MOS Transistor Theory –Device Structure and Physical Operation, Current Voltage Characteristics, MOS Capacitor, Body Effect, Temperature Effects, Channel Length Modulation, Latch-up in CMOS circuits. BiCMOS Technology. Basic Electrical Properties of MOS, CMOS &BiCMOS Circuits: Ids – Vds relationships, Threshold Voltage VT, Gm, Gds and ωo, **UNIT II** MOS Inverter: MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, Design Equations, Transistor Sizing, Voltage Transfer Characteristics, Power Dissipation, Noise Margin, Power Delay Product, Energy dissipation. Combinational MOS Logic Circuits: Pass Transistors/Transmission Gates; Designing with transmission gates: Primitive Logic Gates **UNIT III** Layout Design and Tools: Transistor structures, Wires and Vias, MOS Layers Stick/Layout Diagrams; Layout Design Rules, Scalable Design rules,Issues of Scaling, Scaling factor for device parameters. **UNIT IV** Logic Gates & Layouts: Static Complementary Gates, Switch Logic, Alternative Gate circuits, Low power gates, Resistive and Inductive interconnect delays. **UNIT V** Combinational Logic Networks: Layouts, Simulation, Network delay, Interconnect design, Power optimization, Switch logic networks, Gate and Network testing **UNIT VI** Sequential Systems: Memory cells and Arrays, Clocking disciplines, Design, Power optimization, Design validation and testing.

Textbooks / References:

1. K. EshraghianEshraghian. D, A. Pucknell, Essentials of VLSI Circuits and Systems, , 2005, PHI.

2. Modern VLSI Design – Wayne Wolf, 3rd Ed., 1997, Pearson Education.
3. Ming-BO Lin, Introduction to VLSI Systems: A Logic, Circuit and System Perspective –CRC Press, 2011.
4. N.H.E Weste, K. Eshraghian, Principals of CMOS VLSI Design –, 2nd Ed., Addison Wesley.
5. David A. Johns, Ken Martin, Analog Integrated Circuit Design- Wiley Student Edn, 2013. 6.

- **Design digital Circuit using CMOS.**
  Use EDA tools like Cadence, Mentor Graphics and other open source software tools like Ngspice

Semester-II

Course Code: 20PET202D	***Course Title***	***Credits:03***
Teaching Scheme	**Analog CMOS VLSI Design**	****Evaluation Scheme***
Theory : 03Hrs/week		*Continuous Assessment: 20*
Tutorial:--		*Midsem Exam: 20*
		Endsem: 60

Course Objectives	1.To introduce modelling /design of different circuits using CMOS
Course Outcomes	**CO1** Students will be able to express modeling of passive components **CO2** Students will be able to interpret modeling parameters **CO3** Students will be able to Design CMOS amplifier and operational amplifier **CO4**Students will be able to characterize comparators
Pre-requisites	**Basic knowledge of MOS, CMOS, Linear Circuits.**
Course Type	Program Core Course
Course Contents	**UNIT I** MOS Devices and Modeling: The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout. **UNIT II** CMOS Device Modeling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model. **UNIT III** Analog CMOS Sub-Circuits: MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors-Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference. **UNIT IV** CMOS Amplifiers: Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures. **UNIT V** CMOS Operational Amplifiers: Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power- Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp. **UNIT VI**

	Comparators: Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete Time Comparators.

Textbooks / References:

1. K. EshraghianEshraghian. D, A. Pucknell, Essentials of VLSI Circuits and Systems, , 2005, PHI.
2. Modern VLSI Design – Wayne Wolf, 3rd Ed., 1997, Pearson Education.
3. N.H.E Weste, K. Eshraghian, Principals of CMOS VLSI Design –, 2nd Ed., Addison Wesley.
4. David A. Johns, Ken Martin, Analog Integrated Circuit Design- Wiley Student Edn, 2013. 6. 5. Behzad Razavi, Design of Analog CMOS Integrated Circuits- TMH Edition.
6. CMOS: Circuit Design, Layout and Simulation-Jacob Baker, Li and Boyce, PHI.

- **Design analog Circuit using CMOS.**
  Use EDA tools like Cadence, Mentor Graphics and other open source software tools like Ngspice

Semester-II

Course Code: 20PET204EA	***Course Title***	***Credits:03***
Teaching Scheme	***Memory Technologies***	****Evaluation Scheme***
Theory : 03Hrs/week		*CA1: 20 (Test)*
Tutorial: ----------		*CA2: 20 (Mid Sem)*
		End Sem: 60

Course Objectives	1. To introduce students to different digital memory and to study their construction,characteristics. 2. To introduce students to memory system.
Course Outcomes	At the end of this course students will demonstrate the following skills: - 1. Select appropriate memory system device for various applications. 2. Select appropriate memorydevice for specific applications. 3. Analyze memory signals.
Pre-requisites	microprocessor
Course Type	Program Elective 3
Course Contents	**Unit 1:** **Random Access Memory Technologies:** Static Random Access Memories (SRAMs), SRAM Cell Structures, MOS SRAM Architecture, MOSSRAM Cell and Peripheral Circuit, Bipolar SRAM, Advanced SRAM Architectures,Application SpecificSRAMs. **Unit 2:** DRAMs, MOS DRAM Cell, BiCMOS DRAM, Error Failures in DRAM, Advanced DRAM Design andArchitecture, Application Specific DRAMs.SRAM and DRAM Memory controllers. **Unit 3:** **Non-Volatile Memories:** Masked ROMs, PROMs, Bipolar & CMOS PROM, EEPROMs,Floating GateEPROM Cell, OTP

	EPROM, EEPROMs, Non-volatile SRAM, Flash Memories. **Unit 4:** **Semiconductor Memory Reliability and Radiation Effects:** General Reliability Issues,RAM FailureModes and Mechanism, Nonvolatile Memory, Radiation Effects, SEP, Radiation HardeningTechniques. Process and Design Issues, Radiation Hardened Memory Characteristics, RadiationHardness Assurance and Testing. **Unit 5 :** **Advanced Memory Technologies and High-density Memory Packing Technologies:** Ferroelectric Random Access Memories (FRAMs), Gallium Arsenide (GaAs) FRAMs, AnalogMemories, Magneto Resistive Random Access Memories (MRAMs), Experimental MemoryDevices. **Unit 6:** Memory Hybrids (2D & 3D), Memory Stacks, Memory Testing and Reliability Issues, Memory Cards,High Density Memory Packaging

Text Books:

1. Ashok K Sharma, "Advanced Semiconductor Memories: Architectures, Designs and Applications", Wiley Interscience

Reference Books:

1. Kiyoo Itoh, "VLSI memory chip design", Springer International Edition

Semester-II

Course Code -20PET204EB	***Course Title***	***Credits:04***
Teaching Scheme	***ELECTIVE 3*** ***ARM CONTROLLERS.***	****Evaluation Scheme***
Theory : 03Hrs/week		*CA1: 10*
		CA2: 10 *MSE: 20*
		Endsem: 60

Course Objectives	1 To Understand modern embedded systems and the interface issues related to it. 2 To learn latest microcontrollers and their hardware interfacing. 3 To understand the applications of controller
Course Outcomes	1 Students will be able to Understand the latest technology building block for embedded systems. 2 Students will be able to Interface the hardware to the controller. 3 Students will be able to write Assembly language programs for ARM controllers.
Pre-requisites	Basic knowledge of 8-BIT Processors/Controllers.
Course Type	Program Core Course
Course Contents	**UNIT-1: Introduction**: Overview of embedded systems, embedded system design challenges, common design metrics and optimizing them. Survey of different embedded system design technologies, trade-offs, Custom Single-Purpose Processors, Design of custom single purpose processors. (4)

	UNIT-2: Advanced Microcontrollers: Only brief general architecture of AVR and PIC; Instruction Set Architecture, CISC and RISC instruction set architecture, timers, memory, I/O port expansions, Interrupts, programming with AVR and PIC, Hardware interfacing. (6) **UNIT-3: ARM Processor**: ARM Design Philosophy, ARM Architecture, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, ARM Processor Families. (8) **UNIT-4: Programming:** Instruction Set: Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions, Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instructions, Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions. (8) **UNIT-5: Embedded ARM Applications:** The VLSI Ruby II Advanced Communication Processor, The Ericsson – VLSI Bluetooth Baseband Controller. (4)

TEXT AND REFERENCE BOOKS

1. Frank Vahid, Tony Givargis Embedded System Design: A Unified Hardware/Software Introduction, John Wiley & Sons, Inc.20022.
2. David E. Simon An Embedded software Primer, *Pearson Education*, *1999*
3. MykePredko Programming and Customizing Pic Microcontroller-, *Mc- Graw Hill.*
4. John.B. Peatman, "Design with Pic Micro Controller", *Pearson Education*, *2003.*
5. SteaveFurber, "Arm System – On – Chip Architecture*"* , *PEARSON*
6. Raj Kamal Embedded Systems: Architecture and Programming, *TMH 2012*

Semester-II

Course Code: 20PET204EC	***Course Title***	***Credits:03***
Teaching Scheme	**Low power VLSI Design**	****Evaluation Scheme***
Theory : 03Hrs/week		*Continuous Assessment: 20*
Tutorial:--		*Midsem Exam: 20*
		Endsem: 60

Course Objectives	To match with todays need for low power circuit design for energy efficient systems
Course Outcomes	**CO1**Student will be able to classify causes for various power dissipation **CO2** Student will acquire knowledge of Low-Power Design Approaches **CO3** Student will be able to use Switched Capacitance Minimization Approaches **CO4** Student will be able to design low power adder and multiplier networks **CO5**Student will have knowledge of low power memory technologies
Pre-requisites	**Basic knowledge of CMOS Technology.**
Course Type	Program Specific Elective - III
Course Contents	**UNIT I** Fundamentals: Need for Low Power Circuit Design, Sources of Power Dissipation – Switching

	Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect. **UNIT II** Low-Power Design Approaches: Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. **UNIT III** Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures. **UNIT IV** Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry LookAhead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques –Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles. **UNIT V** Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, BaughWooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier. **UNIT VI** Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell,Prechargeand Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

Textbooks / References:

1. Kiat-Seng Yeo, Kaushik Roy, Low-Voltage, Low-Power VLSI Subsystems –TMH Professional Engineering.
2. Jan M ***Rabaey*** ,AnanthaChandrakasan, and Borivoje Nikolic Digital Integrated Circuits :A ***Design*** Perspective , PHI
3. AnanthaChandrakasan, Low Power CMOS Design –IEEE Press/Wiley International, 1998.
4. Kaushik Roy, Sharat C. Prasad, Low Power CMOS VLSI Circuit Design John Wiley & Sons, 2000.
5. Gary K. Yeap, Practical Low Power Digital VLSI Design –Kluwer Academic Press, 2002. 7. A. Bellamour, M. I. Elamasri, Low Power CMOS VLSI Circuit Design –Kluwer Academic Press, 1995.
6. Siva G. Narendran, AnathaChandrakasan, Leakage in Nanometer CMOS Technologies –Springer, 2005.
7. ParthPratimSahu , 'VLSI Design '.

Semester-II

Course Code: 20PET205EA	***Course Title***	***Credits:03***
Teaching Scheme	***Communication Buses and Interfaces***	****Evaluation Scheme***
Theory : 03Hrs/week		*CA1: 20 (Test)*
Tutorial: ----------		*CA2: 20 (Mid Sem)*
		End Sem: 60

Course Objectives	1. To introduce students to communication signals and to study their characteristics.

	2. To introduce students to different interface system.
Course Outcomes	At the end of this course students will demonstrate the following skills: - 1. Select appropriate bus interface system device for various applications. 2. Select appropriate communicationdevice for specific applications. 3. Analyze interface signals.
Pre-requisites	communication
Course Type	Program Elective 4
Course Contents	**Unit 1:** Serial Busses - Physical interface, Data and Control signals, features, **Unit 2:** limitations and applications of RS232, RS485, I 2 C, SPI **Unit 3:** CAN - Architecture, Data transmission, Layers, Frame formats, applications **Unit 4:** PCIe - Revisions, Configuration space, Hardware protocols, applications **Unit 5:** USB - Transfer types, enumeration, Descriptor types and contents, Device driver **Unit 6:** Data Streaming Serial Communication Protocol - Serial Front Panel Data Port (SFPDP) using fibre optic and copper cable

Text Books:

1. Jan Axelson, "Serial Port Complete - COM Ports, USB Virtual Com Ports, and Ports for Embedded Systems ", Lakeview Research, 2 nd Edition

Reference Books:

1. Jan Axelson, "USB Complete", Penram Publications

Semester-II

Course Code: 20PET205EB	***Course Title***	***Credits:03***
Teaching Scheme	***Network Security and Cryptography***	****Evaluation Scheme***
Theory : 03Hrs/week		*CA1: 20 (Test)*
Tutorial: ----------		*CA2: 20 (Mid Sem)*
		End Sem: 60

Course Objectives	1. To introduce students to network security system design and to study their characteristics. 2. To introduce students to different network security system.
Course Outcomes	At the end of this course students will demonstrate the following skills: - 1. Select appropriate security system device for various applications. 2. Select appropriate network securitydevice for specific applications. 3. Analyze cryptography system.
Pre-requisites	Network system
Course Type	Program Elective 4

Course Contents	**Unit 1:** **Security** - Need, security services, Attacks, OSI Security Architecture, one time passwords, Model for Network security, Classical Encryption Techniques like substitution ciphers, Transposition ciphers, Cryptanalysis of Classical Encryption Techniques. **Unit 2:** **Number Theory** - Introduction, Fermat's and Euler's Theorem, The Chinese Remainder Theorem, Euclidean Algorithm, Extended Euclidean Algorithm, and Modular Arithmetic. **Unit 3:** **Private-Key (Symmetric) Cryptography** - Block Ciphers, Stream Ciphers, RC4 Stream cipher, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Triple DES, RC5, IDEA, Linear and Differential Cryptanalysis. **Unit 4:** **Public-Key (Asymmetric) Cryptography** - RSA, Key Distribution and Management,Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message Authentication Code, hash functions, message digest algorithms: MD4 MD5, Secure Hash algorithm, RIPEMD-160, HMAC. **Unit 5:** **Authentication** - IP and Web Security Digital Signatures, Digital Signature Standards, Authentication Protocols,Kerberos, IP security Architecture, Encapsulating Security Payload, Key Management, WebSecurity Considerations, Secure Socket Layer and Transport Layer Security, Secure ElectronicTransaction. **Unit 6:** **System Security** - Intruders, Intrusion Detection, Password Management, Worms, viruses, Trojans, Virus Countermeasures, Firewalls, Firewall Design Principles, Trusted Systems.

Text Books:

1. William Stallings, "Cryptography and Network Security, Principles and Practices", Pearson Education, 3 rd Edition

Reference Books:

1. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security, Private Communication in a Public World", Prentice Hall, 2 nd Edition

Semester-II

Course Code: 20PET205EC	***Course Title***	***Credits:03***
Teaching Scheme	***Embedded Real Time Operating System***	****Evaluation Scheme***
Theory : 03Hrs/week		*CA1: 20 (Test)*
Tutorial: ----------		*CA2: 20 (Mid Sem)*
		End Sem: 60

Course Objectives	1. To introduce students to real time system design. 2. To introduce students to different real time os system.
Course Outcomes	At the end of this course students will demonstrate the following skills: - 1. Select appropriate real time system device for various applications. 2. Select appropriate real timedevice for specific applications. 3. Analyze real time signals.
Pre-requisites	Embedded system
Course Type	Program Elective 4
Course Contents	**UNIT 1** **Introduction:** Introduction to UNIX/LINUX, Overview of Commands, File I/O,(open, create, close, lseek, read, write), Process Control (fork, vfork, exit, wait, waitpid, exec.) **UNIT 2** **Real Time Operating Systems** Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, Defining a Task, asks States and Scheduling, Task Operations, Structure, Synchronization, **UNIT 3** Communication and Concurrency. Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use **UNIT 4** **Objects, Services and I/O** Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem **UNIT 5** Exceptions, Interrupts and Timers Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations. **UNIT 6** Case Studies of RTOS RT Linux, MicroC/OS-II, Vx Works, Embedded Linux, Tiny OS, and Basic Concepts of Android OS.

Text Books:

1. Qing Li, Elsevier, Real Time Concepts for Embedded Systems , 2011

Reference Books:

1. Rajkamal, Embedded Systems- Architecture, Programming and Design, 2007, TMH.

Semester-II

Course Code: 20PET206L	**Course Title**	**Credits:02**
Execution Scheme		***Evaluation Scheme**
Practical :04Hrs/week	**PG LAB(EMBEDDED LAB)**	**Practical exam:50Marks**

Lab outcomes	1 To implement new ideas with suitable testability and analysis 2 To develop proficiency in EMBEDDED lab techniques 3 To design and build hardware / software for given task 4 Comprehend, illustrate, explain and apply concepts and theories. 5 To write and present analytical technical report
Course Contents	**Individual student or group of two (max)student will perform the work as per following and submit the report based on result obtained and/or study perform under the guidance of respective guide (min 25 pages) The work will be assessed by oral/practical examination of two hours duration by two examiners out of which one will be respective guide or the teacher nominated by head of the department in the absence of respective guide on schedule. second examiner will be eminent teacher or professional / expert from industry.**

Semester-II

Course Code: 20PET207P	**Course Title**	**Credits:02**
Execution Scheme	***MINI PROJECT***	***Evaluation Scheme**
Practical :04Hrs/week	***MINI PROJECT***	**CA: 25 Marks** **Practical Exam: 25 Marks**

Course Objectives	1. To make the students aware about speaking, delivery and presentation skills
Course Outcomes	Upon completing this lab students must be able to:- 1. Deliver project presentation effectively.
Course Contents	The mini project shall be based on the recent trends in the industry, research and open problems from the industry and society. This may include mathematical analysis, modelling, simulation, and hardware implementation of the problem identified. The mini project shall be of the student‟s choice and approved by the guide. The student has to submit the report of thework carried out in the prescribed format signed by the guide and head of the department/institute.

Semester-II

Course Code: 20PET203B	***Course Title***	***Credits:02***
Teaching Scheme	***Internet of Things***	****Evaluation Scheme***
Theory : 02Hrs/week		*CA1: 20 (Test)*
Tutorial: ----------		*CA2: 20 (Mid Sem)*
		End Sem: 60

Course Objectives	1. To introduce students to IoT methods. 2. To introduce students to IoT software
Course Outcomes	At the end of this course students will demonstrate the following skills: - 1. Select appropriate IoT language for research. 2. Select appropriate IoT software. 3. Analyze IoT programs.
Pre-requisites	communication
Course Type	1.3
Course Contents	**UNIT 1** Introduction: What is the Internet of Things: History of IoT, about objects/things in the IoT,Overview and motivations, Examples of applications, IoT definitions, IoT Frame work,General observations, ITU-T views, working definitions, and basic nodal capabilities. **UNIT 2** Fundamental IoT Mechanisms & Key Technologies : Identification of IoT objects andservices, Structural aspects of the IoT, Environment characteristics, Traffic characteristics,scalability, Interoperability, Security and Privacy, Open architecture, Key IoT Technologies,Device Intelligence, Communication capabilities, Mobility support, Device Power, SensorTechnology, RFID technology, Satellite Technology. **UNIT 3** Radio Frequency Identification Technology: Introduction, Principles of RFID, Componentsof an RFID system, Reader, RFID tags, RFID middleware, Issue. Wireless Sensor Networks: History and context, node, connecting nodes, networking nodes, securing communication. **UNIT 4** Wireless Technologies For IoT : Layer ½ Connectivity : WPAN Technologies for IoT/M2M,Zigbee /IEEE 802.15.4, Radio Frequency for consumer Electronics (RF4CE), Bluetooth andits low-energy profile , IEEE 802.15.6 WBANS, IEEE 802.15 WPAN TG4j, MBANS, NFC,dedicated short range communication(DSRC) & related protocols. Comparison of WPANtechnologies cellular & mobile network technologies for IoT/M2M. **UNIT 5** Governance of The Internet of Things: Introduction, Notion of governance, aspects ofgovernance, Aspects of governance Bodies subject to governing principles, privateorganizations, International regulation and supervisor, substantive principles for IoTgovernance, Legitimacy and inclusion of stakeholders, transparency, accountability. IoTinfrastructure governance, robustness, availability, reliability, interoperability, access. Futuregovernance issues, practical implications, legal implications.

	UNIT 6 Internet of Things Application Examples: Smart Metering, advanced metering infrastructure,e-Health/Body area network, City automation, automotive applications. Home automation,smart cards, Tracking, Over-The-Air passive surveillance/Ring of steel, Control applicationexamples.

Text Books:

1. HakimaChaouchi, The Internet of Things, Connecting Objects to the Web, Wiley Publications

Reference Books:

1.Daniel Minoli,Building the Internet of Things with IPv6 and MIPv6 The Evolving World of M2M Communications, Wiley Publications

Semester-III

Course Code: 20PET302MA/ 20PET302MB	**Course Title**	**Credits:02**
Execution Scheme	***Project Management / Intellectual Property Rights (Self Study)#***	***Evaluation Scheme**
Practical :	***Project Management / Intellectual Property Rights (Self Study)#***	**CA: 50 Marks** **Exam: 50 Marks**

Course Objectives	1. To make the students aware about Open Courses
Course Outcomes	Upon completing this lab students must be able to:- 1. Deliver open course content effectively.
Course Contents	The Student has to choose this course either from NPTEL/MOOCs/SWAYAM pool. It is mandatory to get the certification of the prescribed course.

Semester-III

Course Code: 20PET301P	**Course Title**	**Credits:12**
Execution Scheme	***Dissertation Phase – I***	***Evaluation Scheme**
Practical :20 hrs/wk	***Dissertation Phase – I***	**CA: 50 Marks** **Exam: 50 Marks**

Course Objectives	1. To make the students aware about project
Course Outcomes	Upon completing this lab students must be able to:- 1. Deliver project content effectively.
Course Contents	Project-I is an integral part of the final project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature review, project overview, scheme of implementation that may include mathematical model/SRS/UML/ERD/block diagram/ PERT chart, and layout and design of the proposed system/work. As a part of the progress report of project-I work, the candidate shall deliver a presentation on progress of the work on the selected dissertation topic. It is desired to publish the paper on the state of the art on the chosen topic in international conference/ journal. The student shall submit the duly certified progress report of project -I in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.

Semester-IV

Course Code: 20PET401P	**Course Title**	**Credits: 16**
Execution Scheme	***Dissertation Phase – II***	***Evaluation Scheme**
Practical :32 hrs/wk	***Dissertation Phase – II***	**CA: 100 Marks** **Exam: 100 Marks**

Course Objectives	1. To make the students aware about project
Course Outcomes	Upon completing this lab students must be able to:- 1. Deliver project content effectively.
Course Contents	In Project - II, the student shall complete the remaining part of the project which will consist of the simulation/ analysis/ synthesis/ implementation / fabrication of the proposed project work, work station, conducting experiments and taking results, analysis and validation of results and drawing conclusions. It is mandatory to publish the paper on the state of the art on the chosen topic in international conference/ journal. The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.

Semester-I

Audit Course 1

(20PET108H)

Course Code:	*Course Title*	*Credits:00*
Teaching Scheme	***Value Education***	****Evaluation Scheme***
Theory : 02Hrs/week		*Report Submission: 50 Marks*
Tutorial: ----------		

Course Objectives	1. To introduce students to value education methods. 2. To introduce students to value education software
Course Outcomes	At the end of this course students will demonstrate the following skills: - 1. Select value education. 2. Select appropriate value education software.
Pre-requisites	Basic english
Course Type	Audit course 3
Course Contents	**UNIT-1** Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. **UNIT-2** Moral and non- moral valuation. Standards and principles. Value judgements **UNIT-3** 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-4** 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. **UNIT-5** 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-6** Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation.

	Equality, Nonviolence ,Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

Text Books:

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

Semester-II

Audit Course 2

(20PET208H)

Course Code: 20PET208H	***Course Title***	***Credits:00***
Teaching Scheme	***Constitution of India***	****Evaluation Scheme***
Theory : 02Hrs/week		*Report Submission: 50 Marks*
Tutorial: ----------		

Course Objectives	1. To introduce students to constitution. 2. To introduce students to contitution
Course Outcomes	At the end of this course students will demonstrate the following skills: - 1. realize constitution. 2. Select constitutional rights
Pre-requisites	Basic english
Course Type	Audit course 4
Course Contents	**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 Policy

	Fundamental 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.

Text 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.