MCKV INSTITUTE OF ENGINEERING

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Curriculum for Undergraduate Degree (B.Tech.) in Electronics and Communication (VLSI Design) (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Fifth Semester

Course Name:	**Analog VLSI Circuits**		
Course Code:	PC-EC(V)501	**Category**:	Professional Core
Semester:	Fifth	**Credit**:	3
L-T-P:	3-0-0	**Pre-Requisites:**	Analog Electronics Circuits
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To provide in-depth understanding of the analog integrated circuit and building blocks
2	To provide a basic idea on analog VLSI circuits

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Analog IC Design, The Design Flow of Analog ICs, MOSFET Parameters,	4
2	MOSFET models, MOS Diode, MOS Capacitors, MOS Switch, Noise in MOSFETs, MOS Current sources and current sink circuits, Passive and Active Current Mirror , Voltage and Current reference circuits, MOS Gain stages, Source Followers,	10
3	Single Stage Amplifiers, Differential Amplifiers, Operational Amplifiers, Frequency response of Amplifiers ,Band Gap Reference Stability Theory and Compensation in CMOS Operational Amplifiers	10
4	Design Techniques and practical consideration in design of opamp, High Performance CMOS Opamp Design, Design of MOS Comparators,	4
5	Data Converter Fundamentals, Digital-to-analog Converters, Analog-to-Digital Converters, Switch Capacitor Filters,	4
6	Introduction to RF IC Design, Introduction to Power Management and Clocking system, Issues in Analog Layouts.	4
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the MOS fundamentals, small signal models , MOSFET based circuits and layouts
2	Analyze analog circuits such as Differential Amplifier, OP-AMP, Current sources and current sink circuits, Current mirrors, and Biasing circuits.
3	Design of High performance CMOS OPAMP and MOS Comparator
4	Apply the MOS fundamentals for mixed mode circuits such as Comparator, ADCs, DACs, Switch Capacitor Filters

Learning Resources:	
Books	
1	Behzad, Razavi: Design of Analog CMOS Integrated Circuits, MGH, 2001.
2	Allen Holberg: CMOS Analog Integrated Circuit Design, Oxford University Press, 2002
3	VLSI Design 2nd Edition Debaprasad Das, Oxford University Press
4	Sung-Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and Design, McGraw-Hill, 1998..
5	Neil H.E.Weste and Kamran Eshraghian, Principles of CMOS VLSI Design, Addison Wesley, 1998

NPTEL	
1	Analog VLSI CMOS Analog VLSI Design/ Prof. A.N. Chandorkar NPTEL IIT Bombay
2	CMOS Digital VLSI Design/Prof. Sudeb Dasgupta NPTEL IIT Roorkee
3	Analog IC Design/ Prof. S. Aniruddhan NPTEL IIT Madras
4	ANALOG ELECTRONIC CIRCUITS/Prof. S.C.Dutta NPTEL IIT Delhi

Course Name:	**Computer Architecture**		
Course Code:	PC-EC(V)502	**Category:**	Professional Core
Semester:	Fifth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Digital Electronics, Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Know the basic principles of working of a computer
2	Analyze the performance of computers
3	Know how computers are designed and built
4	Understand issues affecting modern processors performance (cache, pipeline etc.)

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Computer Organization & Architecture:** Basic Structure of Computers, Functional units, Structure of IAS Computer, Harvard & Von Neumann architecture, BUS architecture	4
2	**Data Representation:** Floating Point arithmetic, IEEE 754 floating point formats Multiplication & division of unsigned integers	3
3	**Instruction Set:** Machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, CPU Organization, Instruction Length, Addressing modes, Assembly language, Stacks, Subroutines, Instruction cycle	3
4	**ALU Design:** Arithmetic microoperation, Arithmetic unit, Logic unit, Shifter unit, combinational ALU & sequential ALU	3
5	**Memory Organization:** Memory system overview, RAM, ROM, Hierarchical memory technology: Inclusion, Coherence and locality properties, Cache mapping, Techniques for reducing cache misses, Cache writing policies, Associative memories, Memory management, Virtual memory	6
6	**Processor Organization:** Fundamentals, Processor-memory communication, RISC & CISC based architecture	2
7	**Control unit Design**: Instruction sequencing, Interpretation, Hard wired control unit: Design methods, CPU hardwired control unit, Microprogrammed control unit: Basic concepts, Minimizing microinstruction size, Multiplier control unit, CPU Microprogrammed control unit, Nanoprogamming	5
8	**Parallel processing:** Forms of parallel processing, Flynn's classification –SISD, SIMD, MISD, MIMD architectures, Pipelining, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards, Multiple issue processor, Multiprocessor, Array and Vector processors, Basic concepts of ILP, interconnect network	6
9	**Input-Output Organization:** I/O interface, Synchronous and Asynchronous data transfer, Interrupt, DMA, Standard I/O interfaces	2
10	**Overview of HDL:** VHDL/Verilog basics programming concept, Structural, dataflow, behavioral & mixed style modeling techniques	2
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe different components of computer systems
2	Explain different memory structures and mapping techniques
3	Describe parallel computation system
4	Develop simple functional units using VHDL/Veriog
5	Design and solve problems related to CPU architecture, memory management and pipelining

Learning Resources:	
1	Computer Organization & Architecture Designing for performance, Author: W. Stallings; Pearson
2	Computer Organization, Author: Carl Hamacher, Zvonko Vranesic, Safwat Zaky; MGH
3	Computer System Architecture, Author: M.M. Mano; Pearson
4	Advanced Computer Architecture Parallelism, Scalability, Programmability, Author: Kai Hwang & Naresh Jotwani; MGH
5	Computer Architecture and Organization, Author: J.P. Hayes; MGH
6	Structured Computer Organisation, Author: A.S. Tanenbum; Pearson
7	Computer Organization and Programming: With an Emphasis on Personal Computers, Author: C.W.Gear; MGH
8	Circuit Design And Simulation With VHDL, Author: Pedroni; PHI
9	Computer Organization and Design: The Hardware/Software Interface, Author: David A. Patterson, John L. Hennessy; Morgan Kaufmann
10	VHDL: Programming By Example, Author: Douglas Perry; MGH

Course Name:	**Electromagnetic Waves and Transmission Line**		
Course Code:	PC-EC501	**Category**:	Professional Core
Semester:	Fifth	**Credit**:	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic laws of Electromagnetics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understand Characteristics of wave propagation in high frequency Transmission lines
2	Carryout Impedance Transformation in Transmission lines and use as reactive circuit element
3	Characterize Uniform Plane Waves
4	Analyze wave propagation in metallic waveguides
5	Understand principle of Radiation and Radiation characteristics of Antenna

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Basics of Vectors, Vector calculus- Gradient, Divergence and Curl , Basic laws of Electromagnetics i.e Coulomb's law, Gauss' law, Divergence theorem. Current Densities, Biot-Savart's law, Ampere's law, Boundary conditions at Media Interface.	6
2	Time Varying Fields and Maxwell's Equation Faraday's law & Lenz's law, Displacement Current, Relation between Conduction current and Displacement Current density, Maxwell's equations, Time-harmonic fields, Wave Equation.	6
3	Uniform Plane Waves Definition of Uniform plane wave and it's theory , Propagation of plane wave in different media i.e in Free Space, Good Dielectric , Lossy Dielectric and Good Conductor, Concept of Loss tangent and skin depth, Poynting Theorem and Poynting Vector, Wave polarization, phase and group velocity, Surface current and power loss in a conductor, Plane Waves at a Media Interface- Reflection and refraction at dielectric interface, Total internal reflection, wave polarization at media interface, Reflection from a conducting boundary.	8
4	Transmission Lines- Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, Reflection coefficient and Transmission coefficient, Distortion and attenuation in Tx Lines, Condition for minimum distortion, Formation of Standing Waves for different terminations, VSWR and Reflection Coefficient, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart and it's applications in solution of Transmission line problems. Applications of transmission lines: Impedance Matching, use of transmission line sections as reactive circuit elements.	8
5	Wave Guide Analysis of waveguide through general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Concept of cutoff frequency, cutoff wavelength, Guide wavelength, Dominant mode and it's advantages, degenerate mode, evanescent mode, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide.	7
6	Radiation Condition of Radiation, Radiation from the Hertz dipole, Power radiated by hertz dipole, Radiation Parameters of antenna i.e Gain , Directivity, Aperture, Efficiency, Impedance, Bandwidth etc.	5
Total		**40**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand Characteristics of wave propagation in high frequency Transmission lines
2	Carryout Impedance Transformation in Transmission lines
3	Use Transmission line sections for realizing circuit elements
4	Characterize Uniform Plane Waves
5	Analyze wave propagation in metallic waveguides in modal form
6	Understand principle of Radiation and Radiation characteristics of Antenna

Learning Resources:	
1	Elements of Electromagnetics, 4th Edition – Matthew N O Sadiku, Oxford University Press
2	Networks, Lines and Fields, 2nd Edition- John D. Ryder, PHI Learning
3	Electromagnetic Waves & Radiating Systems, 2nd Edition – E. C. Jordan and K.G. Balmain, Pearson Education
4	Electromagnetic Waves – R K Shevgaonkar, Tata-McGraw-Hill

Course Name:	**Digital Signal Processing**		
Course Code:	PC-EC504	**Category:**	Professional Core
Semester:	Fifth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Signals and Systems
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To make students capable to evaluate the spectrum of different discrete time domain signals
2	To make students familiar with the design mechanism of digital IIR and FIR filters
3	To make students aware about LSI systems and its design implications

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Discrete Time domain signals and systems:** Classification of discrete time signals, mathematical operation of discrete time signals, Liner convolution of discrete signals, Inverse system and Deconvolution, Circular convolution, impulse and step response of LTI system, Overlap add method and overlap save method	6
2	**Z-transform and its application in system design:** Z-transform and properties of ROC, Inverse Z-transform, System transfer function and impulse response, Pole-Zero pattern of Z plane, Time domain behavior of single-real- pole, double real pole and complex conjugate pole corresponding to causal signal, S-plane to Z-plane conversion using Impulse invariant method and Bilinear transform, System realization using Direct-1,Direct-2, Cascade and parallel method.	8
3	**Fourier transformation of discrete signals:** Difference between DTFT and DFT, Spectrum development using DFT, Concept of IDFT, Twiddle factor, Radix-2 FFT algorithm, Decimation in time FFT and Decimation in frequency FFT algorithm	6
4	**IIR Filters:** Frequency response and specification of Digital IIR filters, Design of Low pass digital Butterworth filters and normalized transfer function using pole configuration, Design specification of IIR Filters with pass band & stop band attenuation and pass band stop band ripple, Chebyshev low pass digital IIR filter design and its frequency response	8
5	**FIR Filters:** Linear phase FIR filter basic concept, Frequency response of Linear phase FIR Filters, Fourier series method of FIR filter design, Gibbs phenomenon, Rectangular Window, Bartlet Window and Hamming Window for FIR Filter design.	7
6	**Multi rate Signal processing**: Basic concept of multi rate signaling and its application, Decimation(down sampling), Interpolation(up sampling), Anti aliasing and anti imaging Filters, Sampling rate conversion by rational factor I/D, Poly-phase filter structure, Interchanges of Filters and down samplers/ up samplers.	5
Total		**40**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Represents Signal mathematically in Continuous and discrete time and frequency domain
2	Get the response of an LSI system to different signals

3	Design of different types of digital filters for applications

Learning Resources:	
1	Proakis and Manolakis, Digital Signal Processing and applications, Pearson
2	Openhiem & Scaffer - Digital Signal Processing – Pearson India
3	A.Nagoorkani – Digital Signal Ptocessing - TMH
4	V.Udayshankara—Modern Digital Signal Processing , 2/e , PHI
5	S.K. Mitra- Digital Signal Processing, 4th Edition, McGraw Hill.

Course Name:	**Microelectronics and optoelectronic Devices**		
Course Code:	PE-EC(V)501A	**Category:**	Professional Elective
Semester:	Fifth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Knowledge of Physics and Semiconductor Devices
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To introduce the fundamentals of the basic physics behind microelectronics and optoelectronic devices
2	To Become familiar with a wide range of both conventional & novel semiconductor Devices.
3	To impart the different aspects of optoelectronic device physics and its usage in the design and operation of laser diodes, light-emitting diodes, photodetectors and display devices.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Semiconductor Device physics : Charge transport phenomenon, continuity equations, Non equilibrium, Excess carriers in semiconductor, Surface effects, charge storage and diode transients; contact- ohmic and non ohmic.	3
2	Semiconductor Hetero junctions: Energy band diagram, 2-D electron gas, Current Voltage, Characterization, high electron mobility	4
3	Sub-micron MOSFET: MOSFET scaling; Short channel effect, ballistic transport, sub threshold conduction, Silicon on Insulator, Concept of Multi-gate MOSFET.	4
4	Power BJTS and MOSFETs thyristors: Vertical power BJT structure and characterization, Darlington pair, Power MOSFET structure and characterization, thyristors, structure and characterization, trigging,	6

	circuits, Insulated gate bipolar transistor.	
5	Charge transfer devices: Dynamic effects in MOS capacitors, Basic CCD Application of CCD, Thin film Transistors	4
6	Optical processes in semiconductors, radiative and non-radiative recombination processes, Einstein's relations for spontaneous and stimulated emissions and absorption, direct and indirect band-gap semiconductors, ternary and quaternary materials, hetero junctions, coherence properties of light, light as an electromagnetic radiation	4
7	Optoelectronic Devices: Optical processes in semiconductors, absorption, emission, radiation in semiconductors, LED, Laser Diode, Principle of operation, population inversion, gain, lasing threshold condition, semiconductor laser structures	4
8	Photo detectors – Photoconductors, Photodiodes – pn, pin, avalanche photodiodes, photo transistor	4
9	Optoelectronic Modulation and Display Device – Electro-optic and acousto-optic modulators, liquid crystal displays, solar cells, Optoelectronic Integrated Circuits (OEIC)	3
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the band structures of various types of semiconductors and choice of materials for different microelectronic and optoelectronic devices
2	Learn many of the core problems involved with MOSFET technology, and the problems encountered in the continuing push on scaling and miniaturization.
3	Understand the various types of optical sources, characteristics and their applications
4	Understand the various types of optical detectors and modulators, characteristics and their applications.
5	Design system using microelectronic and optoelectronic devices for various applications and analyze their performance.

Learning Resources:	
1	Semiconductor Physics and Devices: Donald A. Neamen, McGraw Hill Education
2	Solid State Electronic Devices: Ben G. Streetman, Sanjay Banerjee, Pearson New International Edition, 6th Edition, 2014
3	S.M. Sze and Kwok. K. Ng, 'Physics of Semiconductor Devices', 3rd Edn., Wiley, 2008.
4	John M Senior, Optical Fiber Communication – principle and practices, 2014, 3rd Edition, PHI, India
5	Optical Fiber Communication: Gerd Keiser, McGraw Hill Education.
6	Semiconductor Optoelectronic Devices: Pallab Bhattacharya, 2nd Edn, Pearson Education Inc.

7	A K Ghatak and K Thyagarajan, Optical Electronics, 2017, 1st Edition, Cambridge University Press, India.

Course Name:	**Advanced Microprocessor**		
Course Code:	PE-EC(V) 501B	**Category:**	Professional Elective
Semester:	Fifth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Microprocessor & Microcontroller PC-EC 403
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Familiarization with ARM architecture, instruction set and programming

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction:** Need of advanced microprocessors, RISC architecture, CISC architecture, development of ARM processor family, ARM architecture.	6
2	**High Performance RISC Architecture – ARM** Arcon RISC Machine, ARM core data flow model, architectural inheritance, core & architectures, registers, memory mapping, data format, pipeline, interrupts, ARM organization, ARM processor family, co-processors.	10
3	**ARM Instruction set and programming:** Data processing instructions, arithmetic and logical instructions, rotate and barrel shifter, branch instructions, load and store instructions, software interrupt instructions, program status register instructions, conditional execution, multiple register load and store instructions, stack instructions, thumb instruction set, advantage of thumb instructions, assembler rules and directives, assembly language programs for shifting of data, factorial calculation, swapping register contents, moving values between integer and floating point registers.	14
4	**Memory management units:** Introduction to memory management unit (MMU), virtual memory, multitasking, memory organization in virtual memory, system, page tables, translation look aside buffer, caches and write buffer, fast context switch extension. **Bus and interface:** Advanced microprocessor bus architecture (AMBA), bus system, user peripherals, exception handling in ARM, ARM optimization techniques.	3 3
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the architecture and instruction set of ARM processor
2	Write assembly language programs
3	Explain the operation and interface of advanced microprocessors
4	Apply the advanced microprocessor understanding in multidisciplinary environment

Learning Resources:	
1	ARM Assembly Language Programming & Architecture By. Muhammad Ali Mazidi, Kindle edition
2	Embedded Systems By. Lyla Das, Pearson publication
3	Arm System Developer's Guide, Designing and Optimizing Software, Andrew N. Sloss, Dominic Symes, Chris Wwight, Elsevier
4	Arm System-on-chip Architecture, 2nd Edition, Steve Furber, Pearson publication
5	Arm Assembly Language, Fundamentals and Techniques, 2nd edition, William Hohl, Christppher Hinds, CRC Press.

Course Name:	**Value and Ethics in Profession**		
Course Code:	HM-HU501	**Category**:	Management Science and Humanities
Semester:	Fifth	**Credit**:	2
L-T-P:	2-0-0	**Pre-Requisites:**	Basic Managerial acumen
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings.
2	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3	To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1.	, Concept of Human Values, Ethics and Profession; Engineering as a profession	2
2.	Societal values: justice, democracy, secularism, rule of law; Maslow's Hierarchy and Integrated personality; Value Crisis in contemporary society	5
3.	Codes of professional ethics. Whistle blowing and beyond. Case studies	3
4	Human Operator in Engineering projects and industries. Problems of man machine interaction	2
5	Rapid Technological growth and depletion of resources. Reports of the Club of Rome. Limits of growth; sustainable development	4
6	Environmental degradation and pollution. Eco-friendly Technologies; Appropriate Technology Movement of Schumacher: later developments	3
7	Emotional Intelligence – Salovey – Mayer Model ;Uses of Ethical Theories – Deontology- Types of Inquiry –Kohlberg's Theory – Gilligan's Argument – Heinz's Dilemma -Intellectual Property Rights	5
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	The students are able to see that verification on the basis of natural acceptance and experiential validation through living is the only way to verify right or wrong, and referring to any external source like text or instrument or any other person cannot enable them to verify with authenticity; it will only develop assumptions.
2	The students are able to grasp the right utilization of their knowledge in their streams of Technology/Engineering/ Management to ensure mutually enriching and recyclable productions systems.
3	The students are able to see that lack of right understanding leading to lack of relationship is the major cause of problems in their family and not the lack of physical facilities in most of the cases, while they have given higher priority to earning of physical facilities in their life ignoring relationships and not being aware that right understanding is the most important requirement for any human being

Learning Resources:	
1	Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994 (2nd Ed)
2	Deborah Johnson, Ethical Issues in Engineering, Prentice Hall, Englewood Cliffs, New Jersey 1991
3	A N Tripathi, Human values in the Engineering Profession, Monograph published by IIM, Calcutta ,1996
4	Samita Manna and Suparna Chakraborti:Values and Ethics in Profession
5.	S.K.Sarangi,Values and Ethics in Profession

Course Name:	**Analog VLSI Circuits Lab**		
Course Code:	PC-EC(V)591	**Category:**	Professional Core
Semester:	Fifth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Analog Electronics and Circuits
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To familiarize with the SPICE tools.
2	To analyze the Analog VLSI circuits
3	To design the Analog VLSI circuits
4.	To Implement the analog sub circuit .

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1.	Introduction to SPICE.(I_d vs V_{DS})	2
2.	Introduction to MOSFET and Device Modeling using SPICE.(.model)	2
3.	Introduction to Sub circuit design	4
4.	Design and analysis of a CMOS invertor Circuit using SPICE	2
5.	Design and analysis of Current Mirror .	2
6.	Design and analysis of Differential Amplifier .	2
7.	Design of CMOS Amplifier and analyze the OPAMP and their Characteristics	2
8.	Design and Simulation of a SRAM using sub circuit method.	2
9.	Implement the Layout of MOS .	2
10.	Innovative Experiment (Introduction to Process Design Kit)	4
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understanding the SPICE tools
2	Analyze the characteristics of Analog VLSI circuits and sub circuits
3	Design the Analog VLSI circuits and sub circuits
4.	Implement the layout of MOS and its allied circuits

Learning Resources:	
1	Laboratory Manual
2	Behzad, Razavi: Design of Analog CMOS Integrated Circuits, MGH, 2001.
3	Allen Holberg: CMOS Analog Integrated Circuit Design, Oxford University Press, 2002

Course Name:	**Computer Architecture Lab**		
Course Code:	PC-EC(V)592	**Category:**	Professional Core
Semester:	Fifth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Digital Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Know different design procedures in VHDL/Verilog
2	Understand the behavior of logic gates, arithmetic, combinational and sequential circuits and design them in VHDL/Verilog
3	Understand the behavior of ALU, RAM and ROM and design them in VHDL/Verilog

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	Overview of HDL: VHDL/Verilog basic programming concept, Structural, dataflow, behavioral & mixed style modeling techniques	2
2	Implementation of logic gates using data flow modeling and behavioral modeling in VHDL/Verilog	2
3	Implementation of NAND, NOR, XOR and a given logic function using structural modeling in VHDL/Verilog	2
4	Design of Half Adder and Full Adder in VHDL/Verilog	2
5	Design of 3 bit array multiplier in VHDL/Verilog	4
6	Design of MUX and decoder using Behavioral modeling in VHDL/Verilog	2
7	Design of shift register using D flip flop in VHDL/Verilog	2
8	Design of counter using JK flip flop in VHDL/Verilog	2
9	Design of memory (RAM, ROM) and perform memory operations in	4

	VHDL/Verilog	
10	Design of 4 bit ALU in VHDL/Verilog	2
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain different design styles in HDL
2	Design basic arithmetic circuits using VHDL/Verilog
3	Design basic combinational circuits using VHDL/Verilog
4	Design basic sequential circuits using VHDL/Verilog
5	Design ALU and memory using VHDL/Verilog

Learning Resources:	
1	Circuit Design And Simulation With VHDL, Author: Pedroni; PHI
2	VHDL: Programming By Example, Author: Douglas Perry; MGH

Course Name:	**Electromagnetic Waves and Transmission Line Lab**		
Course Code:	PC-EC591	**Category:**	Professional Core
Semester:	Fifth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic knowledge of Transmission lines and Antenna
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Understand basic characteristics of Gunn and Klystron oscillators
2	To perform measurement of Guide wavelength, cutoff wavelength in waveguide
3	To perform measurement of unknown impedance using shift in minima technique
4	To perform measurement of HPBW, Directivity of Dipole and Folded Dipole Antenna
5	To perform measurement of HPBW, Directivity and Gain of Pyramidal Horn Antenna

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Introduction and familiarization with RF components	2
2	Study of Gunn Oscillator through V-I characteristics and Tuning	2
3	Study of Klystron oscillator	2
4	Plotting of standing wave pattern along a Tx line under short circuit and resistive load termination	2
5	Measurement of Guide wavelength, cutoff wavelength in waveguide	2

6	Measurement of Impedance of a terminated waveguide using shift in minima technique	4
7	Study on Radiation Pattern of Dipole Antenna (HPBW, Directivity, Front to Back Ratio)	4
8	Study on Radiation Pattern of Folded Dipole Antenna	4
9	Study on Radiation Pattern, Gain, Directivity of Pyramidal Horn Antenna	4
Total		**26**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand handling of test benches using Gunn and Klystron sources
2	Measure the Guide wavelength, cutoff wavelength in waveguide
3	Measure unknown impedance using shift in minima technique
4	Measure the HPBW, Directivity of Dipole and Folded Dipole Antenna
5	Measure the HPBW, Directivity and Gain of Pyramidal Horn Antenna

Learning Resources:	
1	Networks, Lines and Fields, 2nd Edition- John D. Ryder, PHI Learning
2	Basic Microwave Techniques and Laboratory Manual, M.L.Sisodia, G.S. Raghuvanshi, New Age International (P) Ltd.

Course Name:	**Digital Signal Processing Lab**		
Course Code:	PC-EC594	**Category**:	Professional Core
Semester:	Fifth	**Credit**:	1
L-T-P:	0-0-2	**Pre-Requisites:**	Discrete Signals & Systems, Code Composer Studio(CCS), MATLAB
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To generate the elementary signals/ waveforms
2	To Calculate and Plot DFT of given DT signal and prove it theoretical
3	To Implement DFT using FFT algorithm of a given sequence
4	To Plot Magnitude and Phase response of FIR and IIR filter for any given sequence.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	Generation And Display Of Discrete Time domain Signals using MATLAB.	2
2	Addition, Multiplication, Folding, Delay/ Advance operation using MATLAB.	2
3	Linear Convolution using MATLAB and DSP Kit (TMS320C6713).	4
4	Circular Convolution using MATLAB and DSP Kit (TMS320C6713).	4
5	Z- Transform And Inverse Z- Transform Of Various Discrete Sequences.	2
6	Discrete Fourier Transform And Inverse Discrete Fourier Transform of different Discrete Signals Using FFT Algorithm.	2
7	FIR filter design using Rectangular and Blackman windows method.	4
8	Butterworth IIR Filter Design using MATLAB.	2
9	Chebyshev Type- I and Chebyshev Type- II IIR Filter Design using MATLAB	4
Total		**26**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand elementary signals/ waveforms and perform arithmetic operations on signals.
2	Implement FFT of given sequence and identify the reduction of computations using FFT.
3	Analyze frequency response of a given system and verify the properties of LTI system.
4	Design and Implement FIR and IIR filter for a given sequence.

Learning Resources:	
1	Laboratory Manual

Course Name:	**Aptitude Skill Development-I**		
Course Code:	MC571	**Category:**	Mandatory Course
Semester:	Fifth	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	Basic knowledge of Mathematics and English Language
Full Marks:	100		
Examination Scheme:	Semester Examination: NA	Continuous Assessment: 100	Attendance: NA

Course Objectives:	
1	To be familiar with the basic concepts of QUANTITATIVE ABILITY.
2	To be familiar with the basic concepts of LOGICAL REASONING Skills .
3	To be familiar with the basic concepts of PROBABILITY.
4	Acquire knowledge in VERBAL REASONING and VOCABULARY

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	Basics of Quantitative Abilities: Number System, HCF and LCM, Average, Ratio, Proportion and Variations, Problems on Percentage.	4
2	Arithmetic Quantitative Abilities: Problems on Ages, Profit and Loss, Time and Work, Problems on Simple and Compound Interest, Problems on Time, Speed and Distance.	6
3	Permutation and Combination, Set theory, Mensuration and Logarithm.	5
4	Logical Reasoning: Number Series, Alpha Numerical, Letter & Symbol Series, Numerical and Alphabet Puzzles, Seating Arrangement, Blood Relation and Calendars.	7
5	Data Interpretation	2
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the basic concepts of QUANTITATIVE ABILITY.
2	Understand the basic concepts of LOGICAL REASONING Skills .
3	Understand the basic concepts of PROBABILITY.
4	Acquire satisfactory competency in use of VERBAL REASONING

Learning Resources:	
1	Arun Sharma, "Quantitative abilities", McGraw-Hill
2	R.S.Agrawal, "Quantitative Aptitude for Competitive Examinations", S. Chand
3	R.S.Agarwal,"A Modern Approach to Verbal & Non-Verbal Reasoning ",S.Chand

Course Name:	**Essence of Indian Traditional Knowledge**		
Course Code:	MC573	**Category:**	Mandatory Course
Semester:	Fifth	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: NA	Continuous Assessment/Sessional: 100	Attendance: NA

Course Objectives:	
1	To impart basic principles of thought process, reasoning and inferencing.Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature
2	To facilitate students with the concepts of Indian traditional knowledge and to make them understand the importance of the root of knowledge system
3	Holistic life style of Yogic Science and wisdom capsules in Sanskrit Literature are also important in modern society with rapid technological advancements and social disruptions.
4	The Course focuses on Introduction to Indian Knowledge System, Indian Perspective of modern scientific world-view and basic principles of Yoga and holistic health care system.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-àvis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge	4
2	Basic structure of Indian Knowledge Systems (i) Veda (ii) Upa-Veda(iii) Vedanga (iv) Upanga Modern Science and Indian Knowlwdge Systems Yoga and Holistic Health Care Case Studies.	4

3	Protection of traditional knowledge (TK): the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.	4
4	Legal frame work and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indicators act 2003.	4
5	Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge.	4
6	Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.	4
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the concept of Traditional knowledge and its importance
2	Understand the need and importance of protecting traditional knowledge.
3	Understand the various enactments related to the protection of traditional knowledge.
4	Understand the concepts of Intellectual property to protect the traditional knowledge

Learning Resources:	
1	A. Jha, Traditional Knowledge System in India, 2009.
2	B.K. Mohanta and V.K. Singh, Traditional Knowledge System and Technology in India, Pratibha Prakashan, 2012.
3	Shivaramakrishna V(Ed.) Cultural Heritage of India- Course Material, Bharatiya Vidya Bhavan, Mumbai
4	K. Kapoor and M. Danino, Knowledge Traditions and Practices of India, Central Board of Secondary Education, 2012.
5	Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata
6	E-Resources: http://nptel.ac.in/courses/121106003/