

FACULTY OF ENGINEERING
Scheme of Instruction & Examination
(AICTE Model Curriculum for the Academic Year 2019-2020)

and

Syllabus

M.E. I to IV Semester

of

Two Year Post Graduate Degree Programme

in

Electronics and Communication Engineering
Specialization in Digital Systems
(With effect from the academic year 2019– 2020)
(As approved in the faculty meeting held on 25-06-2019)



Issued by
Dean, Faculty of Engineering
Osmania University, Hyderabad – 500 007
2019

SCHEME OF INSTRUCTION & EXAMINATION
M.E. (Electronics and Communication Engineering) I – Semester
Specialization in Digital Systems

S. No.	Course Type/Code	Course Name	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	Core	Program Core – I	3	1	-	4	30	70	3	4
2	Core	Program Core – II	3	-	-	3	30	70	3	3
3	Elective	Professional Elective – I	3	-	-	3	30	70	3	3
4	Elective	Professional Elective – II	3	-	-	3	30	70	3	3
5	MC or OE	Mandatory Course/Open Elective*	3	-	-	3	30	70	3	3
6	Audit	Audit Course – I	2	-	-	2	30	70	3	0
Practical/ Laboratory Courses										
7	Lab-I	Laboratory – I	-	-	2	2	25	50	3	1
8	PC 3154 DS	Seminar	-	-	2	2	25	50	3	1
Total			17	01	04	22	230	520		18

PC: Program Core **PE:** Professional Elective **OE:** Open Elective **AD:** Audit Course
MC: Mandatory Course **HS:** Humanities and Social Science

L: Lecture **T:** Tutorial **P:** Practical **D:** Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note:

- Each contact hour is a Clock Hour.
- The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.
- * If the Mandatory Course is offered in I-Semester, the Open Elective course should be offered in II-semester. If Open Elective course is offered in I-Semester, then the Mandatory Course should be offered in II- semester.
- ** Open Elective Subject is not offered to the students of ECE Department.

SCHEME OF INSTRUCTION & EXAMINATION
M.E. (Electronics and Communication Engineering) II – Semester
Specialization in Digital Systems

S. No.	Course Type/Code	Course Name	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	Core	Program Core – III	3	1	-	4	30	70	3	4
2	Core	Program Core – IV	3	1	-	3	30	70	3	4
3	Elective	Professional Elective – III	3	-	-	3	30	70	3	3
4	MC or OE	Mandatory Course / Open Elective	3	-	-	3	30	70	3	3
5	Audit	Audit Course – II	2	-	-	2	30	70	3	0
Practical/ Laboratory Courses										
6	Lab-II	Laboratory – II	-	-	2	2	25	50	3	1
7	Lab-III	Laboratory – III	-	-	2	2	25	50	3	1
8	PC 3155 DS	Mini Project with Seminar	-	-	4	4	25	50	3	2
Total			14	02	08	23	225	500		18

PC: Program Core **PE:** Professional Elective **OE:** Open Elective **AD:** Audit Course
MC: Mandatory Course **HS:** Humanities and social science

L: Lecture **T:** Tutorial **P:** Practical **D:** Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note:

- Each contact hour is a Clock Hour.
- The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.
- ** Open Elective Subject is not offered to the students of ECE Department.

SCHEME OF INSTRUCTION & EXAMINATION
M.E. (Electronics and Communication Engineering) III – Semester
Specialization in Digital Systems

S. No.	Course Type/Code	Course Name	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	Elective	Professional Elective – IV	3	-	-	3	30	70	3	3
2	Elective	Professional Elective – V	3	-	-	3	30	70	3	3
3	PC 3156 DS	Major Project Phase – I	-	-	20	20	100	-	3	10
Total			06	-	20	26	160	140		16

M.E. (Electronics and Communication Engineering) IV – Semester
Specialization in Digital Systems

S. No.	Course Type/Code	Course Name	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	PC 3157 DS	Major Project Phase – II (Dissertation)	-	-	32	32	-	200	3	16
Total			-	-	32	32	-	200		16

PC: Program Core **PE:** Professional Elective **OE:** Open Elective **AD:** Audit Course

MC: Mandatory Course **HS:** Humanities and social science

L: Lecture

T: Tutorial

P: Practical

D: Drawing

CIE: Continuous Internal Evaluation

SEE: Semester End Examination (Univ. Exam)

Note:

- Each contact hour is a Clock Hour
- The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.
- ** Open Elective Subject is not offered to the students of ECE Department.
- The students who are willing to register for MOOCs in the M.E. (ECE) III – semester instead of Professional Electives – IV & V, should register for those of the courses, approved by the CBoS, OU and respective college MOOCs Coordinator. Those students are strictly not permitted to appear for either CIE or SEE of Professional Electives – IV & V if they abstain from attending the semester class work. Further, for students willing to appear for both MOOCs and Professional Electives, they should fulfill the minimum attendance criteria.

List of subjects of Professional Core

S. No.	Course Code	Course Title
1	PC 3101 EV	Micro Controllers for Embedded System Design
2	PC 3102 DS	Digital Systems Design
3	PC 3103 DS	VLSI Design & Technology
4	PC 3104 DS	Digital Signal Processors

List of subjects of Professional Electives I to V

S. No.	Course Code	Course Title
1	PE 3116 DS	Advanced Digital Design with Verilog HDL
2	PE 3117 DS	Analog IC Design
3	PE 3118 DS	Speech Signal Processing
4	PE 3119 DS	Advanced Computer Organization
5	PE 3120 DS	Modern Digital Communication Systems
6	PE 3121 DS	Wireless Mobile Communication Systems
7	PE 3122 DS	Wireless Channel Coding Techniques
8	PE 3123 DS	GNSS Signals & Receiver Technology
9	PE 3124 DS	Advanced Computer Networks
10	PE 3125 DS	Mobile Adhoc and Sensor Networks
11	PE 3126 DS	Multimedia Information systems
12	PE 3225 ES	Image and Video Processing
13	PE 3319 EV	SoC Design
14	PE 3320 EV	Global and Regional Navigational Satellite Systems
15	PE 3321 EV	Optical Fibre Communication Systems

List of Mandatory Courses

S. No.	Course Code	Course Title
1	MC 5161 ME	Research Methodology & IPR

List of Open Electives

S. No.	Course Code	Course Title
1	OE 9101 CE	Cost Management of Engineering Projects
2	OE 9102 CS	Business Analytics
3	OE 9103 EC**	Embedded System Design
4	OE 9104 EE	Waste to Energy
5	OE 9105 ME	Industrial Safety

Note: ** Open Elective Subject is not offered to the students of ECE Department.

List of subjects of Audit Course-I

S. No.	Course Code	Course Title
1	AD 9001 HS	English for Research Paper Writing
2	AD 9002 CE	Disaster Management
3	AD 9003 HS	Sanskrit for Technical Knowledge
4	AD 9004 HS	Value Education

List of subjects of Audit Course-II

S. No.	Course Code	Course Title
1	AD 9011 HS	Constitution of India and Fundamental Rights
2	AD 9012 HS	Pedagogy Studies
3	AD 9013 HS	Stress Management by Yoga
4	AD 9014 HS	Personality Development through life Enlightenment Skills

List of Laboratory Courses

S. No.	Lab No.	Course Code	Course Title
1	I	PC 3151 DS	Embedded Systems Lab
2	II	PC 3152 DS	Digital System Design Lab
3	III	PC 3153 DS	DSP Lab

Course Code	Course Title				Core/Elective		
PC 3101 EV	Microcontrollers for Embedded System Design				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	4
Course Objectives <ul style="list-style-type: none"> ➤ Detailed overview of important concepts of Embedded system ➤ Analyse PIC microcontroller, its features and programming ➤ Describe ARM Microcontroller architectural details and instruction set ➤ Understand ARM Memory management ➤ Learn the techniques to develop an embedded system and case studies Course Outcomes After completing this course, the student will be able to: <ol style="list-style-type: none"> 1. Define an embedded system with an overview of important concepts and trends in the design process along with the challenges faced in the embedded systems design. 2. Understand the architecture of PIC 18 Microcontroller, its features and programming. 3. Understand ARM Design Philosophy, architectural details, instruction set and ARM Memory Management. 4. Analyse and compare the utility and effectiveness of various debugging tools and techniques. 5. Design a real time based embedded system in the area of communication, automotive, etc. 							

UNIT I

Introduction to Embedded Systems: Overview of Embedded System Architecture, Challenges & Trends of Embedded Systems, Hardware Architecture, Software Architecture. Application areas of Embedded Systems and Categories of Embedded Systems. Embedded System Design and Co-Design issues and Design Cycle Process

UNIT II

PIC 18: Family Overview, Architecture, Instruction Set, Addressing modes. Timers, interrupts of PIC 18, Capture/Compare and PWM modules of PIC 18

UNIT III

ARM Architecture: ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families. Instruction Set: Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions.

UNIT IV

ARM Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instruction Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions. Exception and interrupt handling.

ARM Memory Management: Cache Architecture, Policies, Flushing and Caches, MMU, Page Tables, Translation Access Permissions, Context Switch.

UNIT V

Embedded Software Development Tools, Host and Target Machines, Linkers/Locators for Embedded Software, Getting Embedded Software into the Target System. Debugging Techniques.

Case Studies: Design of Embedded Systems using Microcontrollers – for applications in the area of communication and automotive. (GSM/GPRS, CAN, ZigBee)

Suggested Readings:

1. Raj Kamal, *Embedded Systems – Architecture, Programming and Design*, 2nd Edition, TMH, 2008.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, *ARM Systems Developer's Guides – Designing & Optimizing System Software*, Elsevier, 2008.
3. Mazidi, MCKinlay and Danny Causey, *PIC Microcontrollers and Embedded Systems*, Pearson Education, 2007
4. David.E. Simon, *An Embedded Software Primer*, 1st Edition, Pearson Education, 1999
5. Jonathan W. Valvano, *Embedded Microcomputer Systems, Real Time Interfacing*, Thomas Learning, 1999.

Course Code	Course Title				Core/Elective		
PC 3102 DS	Digital System Design				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	4
Course Objectives <ul style="list-style-type: none"> ➤ Design combinational logic circuits using PLDs and model sequential circuits as finite state machines ➤ Synthesize synchronous sequential circuits and fundamental mode asynchronous sequential circuits ➤ Realize digital systems in terms of State Machines (SM) charts ➤ Model logical faults for combinational circuits using conventional test generation methods ➤ Learn basic fault diagnosis algorithms in sequential circuits Course Outcomes After completing this course, the student will be able to: <ol style="list-style-type: none"> 1. Design combinational logic using PLDs 2. Design synchronous and asynchronous sequential circuits 3. Realize algorithmic state machine (ASM) charts of digital circuits 4. Understand concept of fault modelling and test generation techniques. 5. Learn concepts of fault diagnosis in sequential circuits. 							

UNIT I

Digital Design: Top-Down Modular Combination Logic Design, Combinational circuit Design with Programmable Logic Devices (PLDs).

Sequential circuits design: state table, state diagrams. Latches and Flip-Flops- excitation table, characteristic equations - Mealy, Moore models and Sequence detector

UNIT II

Minimization and Transformation of Sequential Machines: The Finite State Model – Capabilities and limitations of FSM – State equivalence and machine minimization – Simplification of incompletely specified machines.

Fundamental mode model – Flow table, State reduction, Minimal closed covers – Races, Cycles and Hazards.

UNIT III

State Machine Charts: State machine charts, Derivation of SM Charts - Implementation of Binary Multiplier, Realization of SM Chart- Robot controller and Coin operated candy machine design.

UNIT IV

Fault Modelling & Test Pattern Generation: Logic Fault model in combinational circuits – Fault detection and Redundancy, Fault equivalence and fault location, Fault dominance, Single stuck at fault model.

Fault diagnosis of combinational circuits by conventional methods – Path sensitization techniques, Boolean Difference method, and D algorithm. Test generation - Random testing, Transition count testing and Signature analysis.

UNIT V

Fault Diagnosis in Sequential Circuits: Circuit Test Approach, Transition Check Approach – State identification and fault detection experiment, Machine identification, Design of Fault detection experiment.

Suggested Readings:

1. John F. Wakerly, *Digital Design, Principle and Practices*, 3rd Edition, Pearson Education, 2003.
2. CD Victor, P. Nelson, H Troy Nagle, Bill D. Carrol and J David Irwin. *Digital Logic Circuit Analysis and Design*, PHI, 1996.
3. Charles H. Roth, *Fundamentals of Logic Design*, 5th edition, Cengage Learning 2010.
4. Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman, *Digital Systems Testing and Testable Design*, John Wiley & Sons Inc 1990.
5. Parag.K. Lala, *Fault Tolerant and Fault Testable Hardware Design*, BS Publications, 2007.
6. Biswas N.N. *Logic Design Theory*, PHI, 2001.
7. Zvi Kohavi, *Switching and Finite Automata Theory*, TMH, 2001.

Course Code	Course Title				Core/Elective		
PC 3103 DS	VLSI Design and Technology				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	4
Course Objectives <ul style="list-style-type: none"> ➤ Study of the structure and operation of MOS transistor, CMOS Inverter Design, Bipolar Inverter ➤ Design of Combinational logic gates in CMOS and design of Sequential Logic circuits ➤ Demonstrate Lambda based design rules, designing layouts and strategies for building Low power gates ➤ Learn Data path design and study of Semiconductor Memory Design ➤ Design of resistive Interconnect, inductive Interconnect and Interconnect coupling capacitance Course Outcomes After completing this course, the student will be able to: <ol style="list-style-type: none"> 1. Device Fabrication and MOS Transistor analyse of current equation I_d in different modes and its electrical properties. 2. Design of Combinational logic & sequential logic circuits using CMOS transistors 3. Draw stick diagrams and layouts for any MOS transistors and calculate the parasitic R&C 4. Analyse the operation of various arithmetic circuits. 5. Analyse effects of RC delay in interconnects. 							

UNIT I

Transistors and Devices MOS and Bipolar: Introduction, the MOS Transistor structure and operation, Threshold voltage, first order I-V characteristics, velocity saturated current equation, Sub threshold conduction, Capacitance of MOS transistor, MOS Inverter Circuits: Introduction, Voltage Transfer characteristics, Complementary MOS (CMOS) Inverters Design. BiCMOS Inverter.

UNIT II

Designing Combinational Logic Gates in CMOS: Introduction, Static CMOS Design, transmission gate logic and Dynamic CMOS Design

Designing Sequential Logic circuits: Introduction, Static Latches and Registers, Dynamic Latches and Registers

UNIT III

High Speed CMOS Logic Design: Switching Time Analysis, Detailed Load Capacitance Calculation, Improving Delay Calculation with input slope, Gate sizing for optimal Path Delay, Optimizing Paths with logical effort. Scaling of MOS Transistors, Design Rules, Stick diagram and Layout Design

UNIT IV

Data path Design: Adder, Multiplier, Barrel Shifter and Logarithmic shifter.

Semiconductor Memory Design: Introduction, core memory, MOS Decoder, Static RAM cell Design, Memory Architecture Content-Addressable Memories (CAM).

UNIT V

Interconnect Design: Introduction, Interconnect RC Delays, Buffer Insertion very long wires, Interconnect coupling capacitance: Components of Coupling capacitance, coupling effects on Delay, Crosstalk, and Interconnect Inductance.

Suggested Readings:

1. David A Hodges, Horace G Jackson Resve A Saleg *Analysis and Design of Digital Integrated circuits*, McGraw Hill Companies 3rd edition, 2006.
2. Jan M Rabaey, A Chandrakasan, Borvioje N, *Digital Integrated Circuits Design Perspective*, 2nd edition, PHI, 2005.
3. Wayne Wolf, *Modern VLSI Design*, 3rd edition, Pearson Education, 1997.
4. Neil H E Weste Kamran Eshraghian, *Principles of CMOS VLSI Design a system perspective*, 3rd edition, Pearson, 2005.
5. K. Eshraghian, A. Pucknell, *Essentials of VLSI Circuits and Systems*, PHI, 2005.

Course Code	Course Title				Core/Elective		
PC 3104 DS	Digital Signal Processors				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ Analyse and synthesize signals ➤ Compute errors caused by conversion ➤ Describe functional blocks of DSP processor and their use ➤ Understand processors with examples ➤ Design various interfacing devices with processor Course Outcomes <p>After completing this course, the student will be able to:</p> <ol style="list-style-type: none"> 1. Determine DFT using direct and FFT methods. Analyse Circular and Linear convolution, and apply for linear filtering. 2. Compute the errors in DSP System Design & Suggest to Design the Accurate DSP Systems. 3. Discuss the Architectural features of programmable DSP devices & Implement various functional units of DSP Systems. 4. Compare & Comprehend the features of Texas based fixed-point & floating-point DSP Processors. 5. Understand various interfacing signals & interface memory and parallel I/O Peripherals to Programmable DSP Devices. 							

UNIT I

Introduction to Digital Signal Processing: A Digital signal-processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation.

UNIT II

Computational Accuracy in DSP Implementation: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT III

Architectures for Programmable DSP Devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation UNIT, Programmability and Program Execution, Speed Issues, Features for External interfacing. Hardware looping, Interrupts, Stacks, Relative Branch support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models.

UNIT IV

Programmable Digital Signal Processors: Commercial Digital signal-processing Devices: Fixed point DSPs – Architecture of TMS 320C5X, C54X Processors, addressing modes, Memory space, Assembly instructions, Program Control, Pipelining and on-chip peripherals. Floating point DSPs: Architecture of TMS 320 – IX.

UNIT V

Interfacing Memory and I/O Peripherals to Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA). A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.

Suggested Readings:

1. K. Shin, *DSP Applications with TMS 320 Family*, Prentice Hall, 1987.
2. B. Ventakaramani, M. Bhaskar, *Digital Signal Processes, Architecture Processing and Applications*, Tata Mc Graw Hill, 2002.
3. Lapsley et al., *DSP Processor Fundamentals, Architectures & Features*, S. Chand & Co, 2000.
4. Avtar Singh and S. Srinivasan, *Digital Signal Processing*, Thomson Publications, 2004.
5. Woon-Seng Gan, Sen M. Kuo, *Embedded Signal Processing with the Micro Signal Architecture*, Wiley-IEEE Press, 2007.
6. C. Marren & G. Ewess, *A Simple Approach to Digital Signal Processing*, Wiley Inter-science, 1996.
7. R. Vijayarajeswaran, Ananthi.S, *A Practical Approach to Digital Signal Processing*, New Age International, 2009

Course Code	Course Title				Core/Elective		
PE 3116 DS	Advanced Digital Design with Verilog HDL				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ Describe modelling styles of Verilog HDL ➤ Design modelling of Combinational and Sequential Logic modules ➤ Learn synthesis and synthesizers ➤ Understand verification methods and timing analysis ➤ Demonstrate case studies using Verilog HDL Course Outcomes After completing this course, the student will be able to: <ol style="list-style-type: none"> 1. Describe different modelling styles in Verilog HDL 2. Design Verilog codes of Combinational and Sequential Logic modules 3. Understand the design flow of ASICs and FPGA 4. Learn concept of functional verification and timing analysis 5. Design arithmetic and signal processing modules. 							

UNIT I

Review of Verilog HDL, Modelling styles: Behavioural, Dataflow, and Structural Modelling, gate delays, switch-level Modelling, Hierarchal structural modelling.

UNIT II

Modelling of basic MSI Combinational Logic modules and Sequential Logic modules. Finite State Machine modelling.

UNIT III

Synthesis: Design flow of ASICs and FPGA based system, design environment and constraints logic synthesizers, Language structure synthesis, coding guidelines for clocks and reset.

UNIT IV

Verification: Functional verification, simulation types, Test Bench design, Dynamic timing analysis, static timing analysis, value change dump (VCD) files. FPGA based design flow- a case study.

UNIT V

Design Examples: Adders and Subtractors, Multiplication and Division Algorithms, ALU, Digital Signal Processing modules: FIR and IIR Filters, Bus structures, Synchronous & Asynchronous data transfer, UART, baud rate generator. A simple CPU design

Suggested Readings:

1. Ming-Bo Lin., *Digital System Designs and Practices Using Verilog HDL and FPGAs*. Wiley, 2008.
2. Michael D. Ciletti, *Advanced Digital Design with the Verilog HDL*”, PHI, 2005.
3. Samir Palnitkar, “*Verilog HDL: A Guide to Digital Design and Synthesis*”, Pearson Education, 2005.
4. Bhasker J., *Verilog HDL Primer Hardcover*, 2nd Edition, Star Galaxy Publishing ,1999.

Course Code	Course Title				Core/Elective		
PE 3117 DS	Analog IC Design				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ Develop models of basic CMOS amplifiers. ➤ Learn the concepts of advanced current mirrors and band-gap reference circuits. ➤ Design and develop two-stage Opamp. ➤ Analyse applications of Opamp: comparator and oscillator ➤ Familiarize with switched capacitor based circuits. Course Outcomes After completing this course, the student will be able to: <ol style="list-style-type: none"> 1. Describe the small signal model and analyse the small signal amplifiers. 2. Analyse the Current mirrors and Bandgap reference circuits. 3. Design a fully compensated opamp and analyse the frequency response of the opamp. 4. Analyse the applications of opamp i.e. comparator and oscillators. 5. Demonstrate the knowledge of basic filter design and Implement higher order filters using Switched capacitor circuits. 							

UNIT I

Brief Review of Small Signal and Large Signal Model of BJTs and MOSFETs. Current Mirrors and Single Stage Amplifiers – Simple CMOS current mirror, common source amplifier, source follower, common gate amplifier, cascode amplifiers. Source degenerated current mirrors.

UNIT –II

High out impedance – current mirrors, cascode gain stage Wilson current mirror, MOS differential pair and gain stage. Wide swing current mirrors. Bipolar current mirrors – bipolar gain stages. Differential pairs with current mirror loads MOS and bipolar widlar current sources, supply insensitive biasing, temperature insensitive biasing, band gap reference, band gap reference circuits.

UNIT- III

Operational amplifiers, Basic two stage MOS Operational amplifier– Characteristic parameters, Design of two stage opamp. two stage MOS Op-Amp with Cascodes. MOS Telescopic-cascode Op-Amp. MOS Folded cascode op-amp. MOS Active Cascode Op-Amp. Fully differential folded cascode op-amp. CMFB Circuits. Current feedback op-amps. Stability and frequency compensation of op-amps. Phase margin and noise in op-amps.

UNIT – IV

Comparators: Op-Amp Based Comparators, Charge Injection Errors – Latched Comparators – CMOS and BiCMOS Comparators – Bipolar Comparators.

Oscillators and mixers: Basics of oscillators - Feedback oscillators, negative resistance oscillators, (two port oscillators), ring oscillators - Differential ring oscillators, LC oscillators, relaxation oscillators, voltage controlled oscillators, Tuning delay and frequency.

UNIT –V

Switched capacitor circuits: Basic building blocks; basic operation and analysis, inverting and non-inverting integrators, signal flow diagrams, first order filter. Implementation of Higher order filters using switched capacitor circuits.

Suggested Readings:

1. David Johns, Ken Martin, *Analog Integrated Circuit Design*, John Wiley & sons. 2004
2. Behzad Razavi, *Design of Analog CMOS Integrated Circuits*, Tata McGraw Hill. 2002
3. Paul.R. Gray & Robert G. Major, *Analysis and Design of Analog Integrated Circuits*, John Wiley & sons. 2004
4. Jacob Baker.R.et.al., *CMOS Circuit Design*, IEEE Press, Prentice Hall, India, 2000

Course Code	Course Title				Core/Elective		
PE 3118 DS	Speech Signal Processing				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ Describe speech production and perception and modelling ➤ Analyse speech signal and computation ➤ Represent speech with models ➤ Represent speech with coders, encoders and decoders ➤ Learn Automatic Speech Recognition Course Outcomes After completing this course, the student will be able to: <ol style="list-style-type: none"> 1. Understand Production Mechanism, Acoustics Phonetics and Digital model of speech Along with its Perceptions. 2. Understand different approaches of speech signal estimations and transformation and Interpretation techniques. 3. Analyse different Digital models and modulation techniques, and different prediction approaches. 4. Understand different Synthesis, Enhancement approaches concept of re-synthesis methods. 5. Understand automatic Speech recognition techniques, using different Algorithms and Features that Distinguish speaker. 							

UNIT-I

The process of speech production: Production Mechanism and acoustic phonetics. Digital models for speech signals: Vocal Tract, Radiation, Excitation and complete model speech. **perception:** Loudness, Bark Scale, masking, perception and Psychoacoustics.

UNIT-II

Short-time Period analysis: Short-time energy, Average magnitude, zero crossing, Speech vs Silence discrimination and zero crossing rate, Pitch period estimation using parallel processing approach. Autocorrelation function, Pitch period estimation using Auto correlation function, The average magnitude function, median smoothing. Short time Fourier Analysis: Fourier transform interpretation, linear filtering interpretation, sampling rates in time and frequency, Filter banks, Spectrograms, pitch detection. Cepstral analysis, Complex and real cepstrum, pitch detection and Formant estimation.

UNIT-III

Digital Models for Speech Signals: Review of PCM, adaptive PCM, differential PCM, delta modulation. Linear Predictive coding (LPC) analysis: Basic principles, autocorrelation and covariance methods, Computation of LP coefficients, Cholesky decomposition, Durbin's recursive solution, Frequency domain interpretation of LPC, CELP.

UNIT-IV

Analysis by Synthesis: Phase vocoder, subband coding, Formant /homomorphic vocoder, cepstral vocoder, vector quantizer coder, Speech enhancement techniques: Spectral subtraction, enhancement by resynthesis.

UNIT-V

Automatic speech recognition: Basic pattern recognition approaches, evaluating the similarity of speech patterns, Dynamic Time Warping (DTW), HMM's for speech recognition, forward, backward algorithms and parameter estimation. Speaker recognition, Features that distinguish speakers.

Suggested Readings:

1. Rabinar and Schafer, *Digital Processing of Speech Signals*, Pearson Education, 2004.
2. Deller, Hansen, Proakis, *Discrete-Time Processing of Speech signals*, IEEE presses, 2000.
3. R & J Rabinar and Juang, *Fundamentals of speech recognition*, Prentice Hall, 1993.
4. Douglas O'Shaughnessy, *Speech Communication: Human and Machine*, 2nd edition, University Press, Hyderabad, 2001.

Course Code	Course Title				Core/Elective		
PE 3119 DS	Advanced Computer Organization				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ Design CPU organization, Data representation, Pipelining, Superscalar architectures ➤ Learn Hardwired and Micro-Programmed Control UNIT Design ➤ Understand memory organization and hierarchy ➤ Describe IO interfacing concepts ➤ Learn concepts, challenges and limitations of Instruction Level Parallelism (ILP) Course Outcomes <p>After completing this course, the student will be able to:</p> <ol style="list-style-type: none"> 1. Analyse the Computer arithmetic operators. 2. Design of Control Unit of the Computer. 3. Understand the memory organization of the computer. 4. Interface various I/O modules to the computer system. 5. Analyse the multiprocessor environment and various buses for the computer system. 							

UNIT I

Processor Design: CPU Organization, Data Representation, Instruction Formats, Data Path Design: Fixed Point Arithmetic and Floating Point Arithmetic, Instruction Pipelining, Super Scalar techniques, Linear pipeline processors, Super scalar and super pipeline design, Multi vector and SIMD computers.

UNIT II

Control UNIT Design: Basic Concepts: Hardwired Control UNIT Design approach, Micro-programmed Control UNIT Design Approach, Micro program sequencer, Case studies based on both the approaches.

UNIT III

Memory Organization: Internal memory, computer memory system overview, The memory Hierarchy, Random access memories, Cache memory, Elements of cache design, Virtual memory- protection and examples of virtual memory, Replacement Policies.

UNIT IV

Organization: Accessing I/O Devices, Programmed I-O, Interrupts, DMA, Bus Arbitration; Synchronous bus and asynchronous bus, Interface circuits, Parallel port, Serial port, standard I/O interfaces, IO Processor, PCI bus, SCSI bus, USB bus protocols.

UNIT V

Parallel Computer Systems: Instruction Level Parallelism (ILP) – Concept and Challenges, Dynamic Scheduling, Limitations on ILP, Thread Level Parallelism, Multi-processors – Characteristics, Symmetric and Distributive Shared Memory Architecture, Vector Processors and Super computers.

Suggested Readings:

1. Hayes John P; *Computer Architecture and Organization*; 3rd Edition, MGH, 1998.
2. John L. Hennessy and David A. Patterson, *Computer Architecture – A quantitative Approach*, 3rd Edition, Elsevier, 2005.
3. William Stallings, *Computer Organization and Architecture designing for Performance*, 7th edition, PHI, 2007.

Course Code	Course Title				Core/Elective		
PE 3120 DS	Modern Digital Communication Systems				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ Represent communication channel as Band Pass system ➤ Understand Transmission of data and equalization ➤ Compare performance of MSK and Mary receiver ➤ Learn Encryption and decryption of data ➤ Analyse multipath fading Course Outcomes After completing this course, the student will be able to: <ol style="list-style-type: none"> 1. Represent information signals in various forms and understand the concept of band pass systems. 2. Understand the trade-offs between binary, duo-binary and poly-binary signalling schemes. 3. Compare the performance of various digital modulation techniques. 4. Encrypt and decrypt the given message using suitable algorithm. 5. Understand the concept of fading channels and diversity techniques to combat fading. 							

UNIT I

Characterization of Communication signals and systems: Bandpass signals, Linear Bandpass systems and its response, Bandpass stationary stochastic processes, Power spectra of linearly modulated signals.

UNIT II

Baseband Data Transmission: Correlative coding: Duobinary signalling, Duo-binary decoding, Pre-coding, Duo-binary equivalent transfer function, Comparison of Binary with Duo-binary signalling Poly-binary signalling, Inter symbol interference, Equalization.

UNIT III

Bandpass Data Transmission: Coherent and non-coherent modulation and detection of digital (binary and M-ary) signals, Optimum Receiver, MSK, Mary signalling and performances.

UNIT IV

Encryption and Decryption: A model of the encryption and decryption process, cipher systems, stream encryption and public key encrypt systems.

UNIT V

Fading channel characteristics: channel characteristics, channel classification, channel correlation function and power spectra, the effect signal characteristics on the choice of channel model, Mitigation techniques for multipath fading channel: space diversity, frequency diversity, time diversity, multipath diversity and RAKE Receiver, frequency selective and non-selective fading, Example of Radio channels.

Suggested Readings:

1. John G.Proakis, *Digital Communications*, 4thed, McGraw Hill International edition, 2001.
2. Bernard Sklar, *Digital communications fundamentals and Application*, 2nded, Pearson edu, 2001.
3. Fuqin Xiong, *Digital modulation Techniques*, Artech House, 2000.
4. Stephen G. Witson, *Digital Modulation and Coding*, Prentice Hall, New Jessey, 1996.
5. Rodger E. Ziemer and Roger L Peterson, *Introduction to Digital communication*, 2nd edition, Prentice Hall International edition, 2001.

Course Code	Course Title				Core/Elective		
PE 3121 DS	Wireless Mobile Communication Systems				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ Understand Evolution of Cellular Networks, and review of Cellular concepts ➤ Learn Large scale Outdoor and Indoor propagation models ➤ Familiarize with Small scale fading, multipath and Multiple Access techniques ➤ Learn Modulation techniques for mobile radio. ➤ Understand Wireless Networking, Systems and Standards <p>Course Outcomes</p> <p>After completing this course, the student will be able to:</p> <ol style="list-style-type: none"> 1. Understand the method of selection and reuse of a set of frequency channels, Base station requirement, signals required for communication and hand over between Base stations. 2. Appreciate and understand the methods of electromagnetic wave propagation in cellular communication. The evaluation of the electromagnetic energy reaching the mobile unit. 3. Identify factors influencing small scale fading, parameters of mobile multipath channel and also understand different multiple access techniques. 4. Understand different spread spectrum like DSSS, FHSS. 5. Understand traffic routing in wireless network, wireless data services and learn about wireless systems and standards like AMPS ,PTACS,GSM and AIN. 							

UNIT I

Modern Wireless Communication Systems: 1G, 2G, 2.5G, 3G, and 4G technologies.

Cellular Concept: Frequency reuse, Channel assignment strategies, Handoff strategies. Interference and system capacity. Trunking and Grade of service, Improving coverage and capacity in cellular systems

UNIT II

Mobile radio propagation : Large scale propagation free space propagation model. Outdoor propagation models: longely Rice model, Durkin's model, A case study, okumura model, Hata model, PCS Extension to Hata model.

Indoor propagation models: partition losses (same floor), partition losses (between floors), log distance path loss model, ericsson multiple breakpoint model, attenuation factor model, signal penetration into buildings.

UNIT III

Small scale fading & multipaths: Factors influencing small scale fading, small scale multipath measurements, parameters of mobile multipath channel. Types of small scale fading.

Multiple Access techniques: FDMA, TDMA, CDMA.

UNIT IV

Modulation techniques for mobile radio: Constant envelop modulation.

Spread Spectrum Modulation Techniques: PN Sequences. Direct Sequence Spread Spectrum (DS-SS), Frequency hopped Spread Spectrum (FH-SS). Performance of Direct Sequence Spread Spectrum. Performance of Frequency hopped Spread Spectrum.

UNIT V

Wireless Networking: Traffic Routing in Wireless Networks, Wireless Data Services. Common Channel Signalling (CCS), ISDN, Broadband ISDN and ATM. Signalling System No 7. SS7 User Part. Services and Performance.

Wireless Systems and Standards: AMPS and ETACS, GSM. Advanced intelligent network (AIN)

Suggested Readings:

1. Rappaport, “*Wireless Communication*”, Pearson Education, 2nd edition, 2002.
2. William C. Y. Lee, “*Mobile Cellular Telecommunications: Analog and Digital Systems*”, 2nd edition, McGraw-Hill Electronic Engineering Series, 1995.
3. William C.Y. Lee, “*Mobile Communication Engineering*”, Mc-Graw Hill, 1997.
4. Mike Gallegher, Randy Snyder, “*Mobile Telecommunications Networking with IS-41*”, McGraw Hill 1997.
5. Kernilo, Feher, “*Wireless Digital Communications*”, PHI, 2002.

Course Code	Course Title				Core/Elective		
PE 3122 DS	Wireless Channel Coding Techniques				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ Describe performance of digital communication systems. Coding gain. ➤ Design encoder and decoder for various coding schemes ➤ Learn cyclic codes ➤ Analysis of Performance improvement of convolution codes ➤ Design of turbo encoder and decoder Course Outcomes After completing this course, the student will be able to: <ol style="list-style-type: none"> 1. Construct Galois field and know Galois field arithmetic. 2. Learn the encoding and decoding schemes of various linear block codes 3. Generate systematic and non-systematic cyclic codes and Learn BCH codes 4. Understand the structural properties of convolution codes and Viterbi algorithm 5. Realize a turbo encoder and know LDPC codes 							

UNIT I

Introduction: Modulation and coding, Performance measures of coded modulation fields, Binary field arithmetic, construction of Galois Field

UNIT II

Introduction to Linear block codes, the minimum distance of Block codes, Syndrome decoding, Hamming codes, Reed-Muller codes, interleaved codes.

UNIT III

Cyclic codes, Generator and parity-check matrices of cyclic codes, Syndrome computation and error detection. Binary BCH codes, Decoding of BCH codes and Reed Solomon codes.

UNIT IV

Convolutional Codes: Encoding of convolutional codes, Structural properties of convolutional codes. The Viterbi algorithm and BCJR algorithm.

UNIT V

Turbo Coding: Introduction to turbo coding, Performance analysis of Turbo codes, Design of Turbo codes, decoding of Turbo codes, Introduction to LDPC Codes, Tanner graph for Linear Block codes.

Suggested Readings:

1. Shu Lin, Daniel J., Costello, Jr., *Error Control Coding*, 2nd edition, Pearson, 2011
2. Simon Haykin, *Communication Systems*, 4th Edition, John Wiley & Sons, 2007.
3. Proakis J.G. & M. Salehi, *Digital Communications*, Mc Graw-Hill, 2008.
4. Biglieri E., *Coding for Wireless Channels*, Springer, 2007.

Course Code	Course Title				Core/Elective		
PE 3123 DS	GNSS Signals and Receiver Technology				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- Locate user in GNSS available for positioning
- Describe GNSS receiver hardware
- Understand Signal generation, analysis, synthesis and modulation techniques
- Learn Detection of signal and range calculations
- Familiarize with Extraction of information from signal and mitigation of errors

Course Outcomes

After completing this course, the student will be able to:

1. Understand fundamental concepts of GPS and locate user in GNSS available for positioning.
2. Understand GNSS receiver hardware.
3. Explain the concept of signal generation and its analysis with modulation technique.
4. Understand the signal detection and range calculations.
5. Understand the concept of extraction information from signal and mitigate the errors.

UNIT I

Basic GPS Concept: Principle of Operation, Architecture, Space, control and user segments. Other GNSS systems: GLONASS and Galileo. GPS Signal : Signals and Data, GPS Signal Scheme, C/A Code, Gold Sequence, Gold Sequence Generation, Correlation Properties, Doppler Frequency Shift, Code Tracking, Navigation Data, Telemetry and Handover Words, Data in Navigation Message. Galileo Signal: Galileo L1 OS Signal: Signal Generation, Coherent Adaptive Sub-carrier Modulation, Binary Offset Carrier Modulation, and Message Structure: Frames and Pages Cyclic Redundancy Check, Forward Error Correction and Block Interleaving, Message Contents: Time and Clock Correction Parameters, Conversion of GST to UTC and GPST, Service Parameters, the Received L1 OS Signal, GLONASS and other GNSS signals.

UNIT II

GNSS Receiver Operation Overview: Receiver Channels, Acquisition, Tracking, Navigation Data Extraction, Computation of Position, GNSS Antennas and Front Ends: GNSS L1 Front-End Components, GNSS Antenna, Filter, Amplifier, Mixer/Local Oscillator, Analog-to-Digital Converter, Resulting Sampled Data, GNSS Front-End ASICs.

UNIT III

Acquisition: Serial Search Acquisition, PRN Sequence Generation, Carrier Generation, Integration and Squaring, Parallel Frequency Space Search Acquisition, Parallel Code Phase Search Acquisition, Data Size, Execution Time, Parameter Estimation.

UNIT IV

Carrier and Code Tracking: Motivation, Demodulation, Second-Order PLL, Damping Ratio, Noise Bandwidth, Carrier Tracking, Code Tracking, Multipath, Complete Tracking Block, Pseudo-range Computations.

UNIT V

Data Processing for Positioning, Navigation Data Recovery, Finding the Bit Transition Time and the Bit Values, Navigation Data Decoding, Location of Preamble, Extracting the Navigation Data, Computation of Satellite Position, Pseudo-range Estimation, The Initial Set of Pseudo-ranges, Estimation of Subsequent Pseudo-ranges, Computation of Receiver Position, Time, Linearization of the Observation Equation, Using the Least-Squares Method, Real-Time Positioning Accuracy, Time Systems Relevant for GPS, Coordinate Transformations, Universal Transverse Mercator Mapping, Dilution of Precision, World Geodetic System 1984, Time and Coordinate Reference Frames for GPS and Galileo

Suggested Readings:

1. Kai Borre, Dennis M. Akos, Nicolaj Bertelsen, Peter Rinder, Søren Holdt Jensen, *A Software-Defined GPS and Galileo Receiver A Single-Frequency Approach*, Birkhauser, Boston, 2007
2. James Bao-Yen Tsui, *Fundamentals of global positioning system receivers: a software*, Wiley Inter-science, 2005
3. Hofmann-Wellenhof, Bernhard, Lichtenegger, Herbert, Wasle, Elmar GNSS – Global Navigation Satellite Systems: GPS, GLONASS, Galileo, and More, Springer, 2008.

Course Code	Course Title				Core/Elective		
PE 3124 DS	Advanced Computer Networks				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ Overview of computer networks, internet, and foundation of basic networking protocols. ➤ Detailed study of Link layer, Routing and Congestion control at the network layer. ➤ Learn Protocols in Network layer, Transport layer, and Application Layer. ➤ Describe Concepts of Tunnelling, VPN's, Multimedia Networking Protocols, and Optical networks. ➤ Overview of Wireless Networks, Mobile IP, Mobile A-Hoc and Wireless Sensor Networks 							
Course Outcomes After completing this course, the student will be able to: <ol style="list-style-type: none"> 1. Describe the internet and compare the layered architectures. 2. Explain the various routing algorithms and congestion control mechanisms at the network layer. 3. Paraphrase the services & protocols of network, transport and application layer. 4. Discuss the concepts in multimedia networking and optical networks. 5. Compare and contrast Ad hoc and wireless sensor networks. 							

UNIT I

Computer Networks and the Internet: What is the Internet, The Network edge, The Network core, Access Networks and Physical media, ISPs and Internet Backbones, Delay and Loss in Packet-Switched Networks.

Foundation of Networking Protocols: 5-layer TCP/IP Model, 7-Layer OSI Model, Internet Protocols and Addressing, Equal-Sized Packets Model.

UNIT II

Link Layer and Local Area Networks: Introduction and Services, Error-Detection and Error-Correction techniques, Multiple Access Protocols, LAN Addresses and ARP, Ethernet, Hubs, Bridges and Switches, PPP: The Point-to-Point Protocol

Wide Area Routing: Path Selection Algorithms - Dijkstra's Algorithm, Bellman-Ford Algorithm, Packet Flooding and Deflection Routing Algorithm.

Congestion Control at the Network Layer : Unidirectional Congestion Control, Bidirectional Congestion Control, Random Early Detection (RED).

UNIT III

Network layer: Internet Protocol: Internetworking, IPv4, IPv6 Transition from IPv4 to IPv6.

Multicast Routing and Protocols: Basic Definitions and Techniques, Internet Group Management Protocol (IGMP).

Transport and End-to-End Protocols: User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Mobile Transport Protocols, TCP Congestion Control.

Application Layer: The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, Domain Name System (DNS).

UNIT IV

Tunneling, VPN's and MPLS Networks – Tunneling, Virtual Private Networks (VPNs), Multiprotocol Label Switching (MPLS).

Multimedia Networking - Protocols for Real – Time Interactive Applications – RTP, RTCP, SIP, and H.323. Overview of Voice over IP, SIP to H.323, SIP to PSTN, Wireless Cellular Multimedia Internetworking.

Optical Networks and WDM Systems: Overview of Optical Networks, Basic Optical Networking Devices, Large-Scale Optical Switches, Optical Routers, Wavelength Allocation in Networks, Case Study: An All-Optical Switch.

UNIT V

Wireless Networks and Mobile IP: Infrastructure of Wireless Networks, Wireless LAN Technologies, IEEE 802.11 Wireless Standard, Cellular Networks, Mobile IP, Wireless Mesh Networks (WMNs). **Mobile A-Hoc Networks:** Overview of Wireless Ad-Hoc Networks, Routing in Ad-Hoc Networks, Routing Protocols for Ad-Hoc Networks

Wireless Sensor Networks: Sensor Networks and Protocol Structures, Communication Energy Model, Clustering Protocols- LEACH Clustering and DEEP Clustering Protocol, Routing Protocols

Suggested Readings:

1. James F. Kurose, Keith W. Ross, *Computer Networking: A Top-Down Approach Featuring the Internet*, 3rd Edition, Pearson Education, 2007
2. Nader F. Mir, *Computer and Communication Networks*, Pearson Education, 2007
3. Behrouz A. Forouzan, *Data Communications and Networking*, 4th Edition, Tata McGraw Hill, 2007
4. Greg Tomsho, Ed Tittel, David Johnson, *Guide to Networking Essentials*, 5th Edition, Thomson.
5. S. Keshav, *An Engineering Approach to Computer Networking*, Pearson Education.
6. Diane Teare, Catherine Paquet, *Campus Network Design Fundamentals*, Pearson Education (CISCO Press)
7. Andrew S. Tanenbaum, *Computer Networks*, 4th Edition, Prentice Hall.
8. William Stallings, *Data and Computer Communications*, 8th Edition, Pearson Prentice Hall, 2007.

Course Code	Course Title				Core/Elective		
PE 3125 DS	Mobile Adhoc and Sensor Networks				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- Outline of sensing, computing and communication elements
- Describe Data dissemination and accumulation, catching and storage
- Detection of signal topology, management and topological routing. Dispersed sensors covering geographic area
- Learn Synchronization of signals and recognition channel sharing and locality
- Understand Identification and error detection and routing of signals, sensor nodes have limited energy, limited communication and computational capabilities and limited memory

Course Outcomes

After completing this course, the student will be able to:

1. Compare and contrast Ad hoc and wireless sensor networks, describe the various routing protocols and simulators.
2. Recognize networking methods like IEEE 802.11 and Bluetooth.
3. Explain single node and network architecture, operating system and programming languages, MAC layer protocols.
4. Describe control, clustering, time synchronization, localization and positioning, routing.
5. Discuss addressing and synchronization.

UNIT I

Introduction: mobile ad hoc networks (MANETs) and wireless sensor networks (WSNs), concepts and architectures, Routing: proactive routing, reactive routing (on demand), hybrid routing, power-aware routing, Network simulators (OPNET, NS2, etc.)

UNIT II

Broadcasting and multicasting: broadcast storm, network flooding avoidance, multicast routing, TCP over mobile ad hoc networks: IP address acquisition, effects of partitions on TCP, provisions for mobility and fairness, Wireless LAN (Wi-Fi): 802.11 specifications, Medium Access Control Protocol issues; power control, spatial reusability, and QoS. Bluetooth: specifications, Piconet synchronization and master-slave switch, scatter-net formations, interference issues, interoperability with Wi-Fi.

UNIT III

Wireless sensor networks (WSNs): single node architecture: hardware and software components of a sensor node, Tiny OS operating system, nesC language, WSN Network architecture: typical network architectures, data relaying strategies, aggregation, role of energy in routing decisions, WSN MAC layer strategies: MAC layer protocols, energy management, contention-based protocols, schedule-based protocols, standard.

UNIT IV

WSN naming and addressing: addressing services, publish-subscribe topologies, WSN Clock Synchronization: clustering for synchronization, sender-receiver and receiver-receiver synchronization. Error analysis

UNIT V

WSN Node Localization: absolute and relative localization, triangulation, multi-hop localization and error analysis, anchoring, geographic localization, WSN Routing: Agent-based routing, random walk, trace routing.

Suggested Readings:

1. C.Siva Ram Murthy and B.S.Manoj, *Ad Hoc Wireless Networks: Architectures and Protocols*, Prentice Hall PTR, 2007.
2. Holger Karl and Andreas Willig, *Protocols and Architectures for Wireless Sensor Networks*, WILEY (ISBN: 0-470-09510-5)
3. C. Siva Ram Murthy and B. S. Manoj, *Ad Hoc Wireless Networks: Architectures and Protocol*, Prentice Hall, 2004.
4. Feng Zhao and Leonidas J. Guibas, *Wireless Sensor Networks: An Information Processing Approach*, Morgan Kaufmann, 2004
5. Kazem Sohraby, Daniel Minoli and Taieb Znati, *Wireless Sensor Networks Technology-Protocols and Applications*, John Wiley & Sons, 2007.
6. Charles E. Perkins, *Ad Hoc Networking*, Addison Wesley, 2000.

Course Code	Course Title				Core/Elective		
PE 3126 DS	Multimedia Information Systems				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ Describe information on digital media ➤ Outline networking synchronization of various systems ➤ Study methods of computation, analyse various models ➤ Study methods for interfacing different systems with different sampling ratio ➤ Learn reconstruction of signals, coding and decoding Course Outcomes After completing this course, the student will be able to: <ol style="list-style-type: none"> 1. Learn and Understand technical aspects of Multimedia Systems along with applications. 2. Understand various networking aspects used for Multimedia applications. 3. Understand motion estimation techniques. 4. Understand multirate signals and also able to understand audio encoders and decoders. 5. Compare IR and DBMS basic IR models. 							

UNIT I

Definition of Multimedia, Multimedia system description. Applications of Multimedia. **Types of Multimedia:** a non-interactive, interactive. Hypertext.

UNIT II

Multimedia Networking: ATM. ISDN. WAN and their comparisons, Multimedia synchronization. Serial and Parallel.

UNIT III

Motion estimation techniques: Bruteforce, algorithm three step, search algorithm. 2-D algorithm and conjugate direction search algorithm.

Image compression standards: Review on loseless and lossy compression models. JPEG. H261 MPEG1, MPEG2 and MPEG4.

UNIT IV

Audio coding: Introduction to multi rate signals. MPEG1 and MPEG2 audio encoder and decoder.

UNIT V

Multimedia information indexing and Retrieval: General information Retrieval (IR) model. Differences between IR and DBMS Basic IR models. File structure, audio indexing and Retrieval methods. Image Retrieval based on shape and moments and watermarking Techniques.

Suggested Readings:

1. Guojun Lu, *Communication and Computing for distributed multimedia systems*, Artech House, Boston, London, 1995.
2. Bhaskar, V and Konstantindes K, *Image and Video Compression Standards algorithms and Architecture*, Kluwer Academic, Sept, 1997.
3. Judith Jeffocate, *Printmedia in practice (Theory and Applications)*, PHI, 1998.

Course Code	Course Title				Core/Elective		
PE 3225 ES	Image and Video Processing				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ Study fundamental concepts of Image Processing and various Image Transforms ➤ Learn Image Enhancement Techniques in Spatial and Frequency domain, Image Segmentation methods ➤ Familiarize with fundamentals of Image compression, Lossy & Lossless Compression methods. ➤ Define concepts of Video Processing, Image Formation models, and processing of Video signals. ➤ Understand general methodologies of 2 D Motion Estimation and Video coding methods. Course Outcomes After completing this course, the student will be able to: <ol style="list-style-type: none"> 1. Use different transforms for various applications like Image Enhancement ,Compression etc.. 2. Use Spatial and Transform techniques to Enhance the given image and to extract the features of the image. 3. Use Lossless and Lossy compression techniques for real time applications. 4. Understand the fundamental concepts of Video capturing and Three Dimensional Motion Models. 5. Understand and analyse various Motion estimation techniques. 							

UNIT I

Fundamentals of Image Processing and Image Transforms: Basic steps of Image Processing System, Sampling and Quantization of an image, relationship between pixels

Image Transforms: 2 D- Discrete Fourier Transform, Discrete Cosine Transform (DCT), Wavelet Transforms: Continuous Wavelet Transform, Discrete Wavelet Transforms.

UNIT II

Image Processing Techniques: Image Enhancement: Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters.

Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering. Laplacian of Gaussian (LOG) filters.

Image Segmentation: Segmentation concepts, Point, Line and Edge Detection, Thresholding, Region Based segmentation, Hough Transform, Boundary detection, chain coding.

UNIT III

Image Compression: Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy & Lossless, Huffman coding, Arithmetic coding, LZW coding, Run length coding, Bit plane coding, Transform coding, Predictive coding, Wavelet coding, JPEG Standards.

UNIT IV

Basic concepts of Video Processing: Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

UNIT V

Motion Estimation: Optical flow, General Methodologies, Pixel Based Motion Estimation, Block- Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding, constant dependent video coding and joint shape and texture coding .MPEG and H.26X standards.

Suggested Reading:

1. Gonzalez and Woods, *Digital Image Processing*, 3rd edition, Pearson.
2. Yao Wang, Joem Ostermann , Ya–quin Zhang, *Video processing and communication*, 1st Edition, PH Int.
3. S.Jayaraman, S.Esakkirajan, T.Veera Kumar *Digital Image Processing*, TMH, 2009.
4. M. Tekalp, *Digital Video Processing*, Prentice Hall International
5. John Woods, *Multi-dimensional Signal, Image and Video Processing and Coding* 2nd Edition, Elsevier.
6. Vipula Singh, *Digital Image Processing with MATLAB and LabVIEW*, Elsevier, 2013
7. Keith Jack, *Video Demystified – A Hand Book for the Digital Engineer*, 5th Edition, Elsevier.

Course Code	Course Title				Core/Elective		
PE 3319 EV	SoC Design				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ Understand Integration of hardware and software on a single chip ➤ Describe various processors ➤ Design of Memory for SoC ➤ Familiarize with Interconnection of various devices and reconfiguration ➤ Explore various application of system on single chip Course Outcomes <p>After completing this course, the student will be able to:</p> <ol style="list-style-type: none"> 1. Apply fundamental knowledge of digital logic design to modelling and analysis of low power in processor design. 2. Understand the design concepts of processor, pipelining concepts, ARM Development Tools and Interfacing ARM with Co-processors. 3. Understand the concepts of Memory Hierarchy, Cache design and Memory Management. 4. Develop an understanding of various interconnect schemes for system Development. 5. Design a simple SoC for reconfigurability/low power/ASIP/NISC etc. 							

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

Suggestive Readings:

1. Ricardo Reis, “*Design of System on a Chip: Devices and Components*, 1st Ed., Springer, 2004.
2. Michael J. Flynn and Wayne Luk, *Computer System Design System-on-Chip*, Wiley India Pvt. Ltd.
3. Steve Furber, *ARM System on Chip Architecture*, 2nd Ed., Addison Wesley Professional, 2000.
4. Jason Andrews, *Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology)*, Newnes, BK and CDROM.
5. Prakash Rashinkar, Peter Paerson and Leena Singh L, *System on Chip Verification – Methodologies and Techniques*, Kluwer Academic Publishers, 2001.

Course Code	Course Title				Core/Elective		
PE 3320 EV	Global and Regional Navigation Satellite Systems				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ Familiarize with GNSS fundamentals ➤ Learn GNSS signal structure, errors and their modelling ➤ Understand GPS errors and their modelling techniques ➤ Study GPS integration and data processing techniques ➤ Analyse GNSS augmentation and Regional navigation systems <p>Course Outcomes</p> <p>After completing this course, the student will be able to:</p> <ol style="list-style-type: none"> 1. Understand the principle & operation of GPS. 2. Frame various co-ordinate systems for estimating positions. 3. Estimate the various errors and their effect on position estimation. 4. Use GPS in various fields such as navigation GIS etc. 5. Apply DGPS principle and can also analyse various augmentation system. 							

UNIT I

GPS fundamentals: GPS principle of operation, architecture, operating frequencies, orbits, Keplerian elements. Solar and Sidereal day, GPS and UTC Time

Other GNSSs: Architecture and features of Russian Global Navigation Satellite System (GLONASS), European Navigation System (Galileo), Chinese Global Navigation System (BeiDou-2/COMPASS).

UNIT II

GNSS Signals: Original and modernized GPS, GLONASS and Galileo signal structure, Signal components and modulation schemes. Important components of a receiver for the acquisition and tracking of GPS signals.

GNSS Datums: Datums used for GPS and Galileo (ECEF and WGS 84). Datum used by Russian GLONASS and Indian Datums.

UNIT III

GPS Error Models: Ionospheric error, Tropospheric error, Ephemeris error, Clock errors, Satellite and receiver instrumental biases, Antenna Phase center variation, multipath; estimation of Total Electron Content (TEC) using dual frequency measurements, Various DOPs, UERE. Spoofing and Anti-spoofing. Link budget. Klobuchar model, Hopfield model and modelling of multipath error.

UNIT IV

GPS data processing: RINEX Navigation and Observation formats, Code and carrier phase observables, linear combination and derived observables, Ambiguity resolution, cycle slips, Position estimation.

GPS integration: GPS/GIS, GPS/INS, GPS/pseudolite, GPS/cellular.

UNIT V

Augmentation systems: Relative advantages of SBAS and GBAS, Wide area augmentation system (WAAS) architecture, GAGAN, EGNOS and MSAS. Principle of operation of DGPS, architecture and errors. Local area augmentation system (LAAS) concept.

Regional Navigation Satellite Systems (RNSS): Chinese Area Positioning System (CAPS). Indian Regional Navigation Satellite System (IRNSS), Japan's Quasi-Zenith Satellite System (QZSS).

Suggested Readings:

1. Pratap Misra and Per Enge, *Global Positioning System Signals, Measurements, and Performance*, Ganga-Jamuna Press, Massachusetts, 2001.
2. Rao G.S., *Global Navigation Satellite Systems - With Essentials of Satellite Communications*, Tata McGraw Hill, 2010.
3. B.Hofmann Wollenhof, H.Lichtenegger, and J.Collins, *GPS Theory and Practice*, Springer Wien, New York, 2000.
4. Ahmed El-Rabbany, *Introduction to GPS*, Artech House, Boston, 2002.
5. Bradford W. Parkinson and James J. Spilker, *Global Positioning System: Theory and Applications*, Volume I and II, American Institute of Aeronautics and Astronautics, Inc., Washington, 1996.
6. E-book available on: http://www.unoosa.org/pdf/publications/icg_ebook.pdf

Course Code	Course Title				Core/Elective		
PE 3321 EV	Optical Fibre Communication Systems				Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ Analyse optical fibre as wave guide ➤ Learn various optical sources and detectors used in optical signal transmission ➤ Familiarize with various components used in optical communication like, preamplifiers, links ➤ Estimate Performance evaluation of optical communication ➤ Explore applications of optical communication in Local Area Networks Course Outcomes After completing this course, the student will be able to: <ol style="list-style-type: none"> 1. Understand different types of optical fiber, mode theory and Signal degradation in Optical fiber. 2. Identify the merits and demerits of various Optical Sources and detectors in Optical Communication. 3. Understand point to point link and receiver performance. 4. Know the different Components used in Optical Communication Link. 5. Design WDM system with various system consideration. 							

UNIT I

Optical Fibres: Fibre Structures, Wave-guiding and fabrications, Overview of Optical fibre communications, Elements of an Optical fibre transmission Link, Nature of light, Basic optical laws and definitions, Modes and configurations, Mode theory of circular wave guides, Single, Multi mode step index and Graded index Fibres , Fibre materials. Signal degradation in Optical Fibres. Dispersion, Pulse broadening in graded index fibres, Mode coupling, Design optimization of single mode Fibres.

UNIT II

Optical Sources & Detectors: Semiconductors as optical Sources and their fabrication. LED and Laser diodes, Linearity of sources, Modal, Partition and reflection noise, Physical principles of PIN and APD, Photo detector noise, detector response time, Avalanche multiplication noise, Temperature effect on avalanche gain, Comparison of Photo detectors.

UNIT III

Optical Fibre communication: Basic communication system, Fundamental receiver operation, Digital receiver performance calculations. Preamplifiers types, Analog receivers. Fibre Links: Point to point links, Line coding, Error correction, Noise effects on digital transmission system performance. Overview of analog links, Carrier noise ratio in analog systems.

UNIT IV

Multi-channel transmission techniques: WDM concepts and components. Operational principles of WDM, Passive components, Tunable sources, Tunable filters, Introduction of optical amplifiers.

UNIT V

Optical Networks: Basic Networks, SONET/SDH, Broadcast and select WDM networks, Wavelength Routed Networks, Nonlinear effects on Network Performance, Performance of EDFA+WDM systems, Optical CDMA, Ultrahigh capacity Networks.

Suggested Readings:

1. Djafar K.mynbaev Lowell I.Scheiner “Fibre Optic Communications Technology”, Pearson Education Asia.
2. Senior John M. “Optical Fibre Communications Principles and Practice”, Prentice Hall India, second edition, 1996
3. Keiser Gerd, “Optical Fibre Communications”, McGraw Hill, second edition,1991

Course Code	Course Title				Core/Elective		
MC 5161 ME	Research Methodology and IPR				Mandatory Course		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives To make students to <ul style="list-style-type: none"> ➤ Motivate to choose research as career ➤ Formulate the research problem, prepare the research design ➤ Identify various sources for literature review and data collection report writing ➤ Equip with good methods to analyse the collected data ➤ Know about IPR copyrights Course Outcomes At the end of this course, students will be able to: <ol style="list-style-type: none"> 1. Define research problem, review and assess the quality of literature from various sources 2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs 3. Collect the data by various methods: observation, interview, questionnaires 4. Analyse problem by statistical techniques: ANOVA, F-test, Chi-square 5. Understand apply for patent and copyrights 							

UNIT - I

Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods Verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT - II

Literature Survey and Report writing: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Need of Review, Guidelines for Review, Record of Research Review.

Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanism of writing a report. **Research Proposal Preparation:** Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

UNIT - III

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT - IV

Data Collection and Analysis: Methods of data collection, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data. Importance of Parametric, non-parametric test, testing of variance of two normal populations, use of Chi-square, ANOVA, F-test, z-test

UNIT - V

Intellectual Property Rights: Meaning, Nature, Classification and protection of Intellectual Property, The main forms of Intellectual Property, Concept of Patent, Patent document, Invention protection, Granting of patent, Rights of a patent, Licensing, Transfer of technology.

Suggested Readings:

1. C.R Kothari, Research Methodology, Methods & Techniques; New Age International Publishers, 2004
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011
3. Y.P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling Publications Pvt. Ltd., New Delhi, 2004
4. G.B. Reddy, Intellectual Property Rights and the Law 5th Ed. 2005 Gogia Law Agency
5. Ajit Parulekar and Sarita D'Souza, Indian Patents Law – Legal & Business Implications, Macmillan India Ltd, 2006

Course Code	Course Title				Core/Elective		
OE 9101 CE	Cost Management of Engineering Projects				Open Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives <ul style="list-style-type: none"> ➤ To apply modern software packages to conduct analysis of real world data. ➤ To understand the technical underpinning of engineering economic analysis. ➤ The ability to apply the appropriate analytical techniques to a wide variety of real world problems and data sets. ➤ To summarize and present the analysis results in a clear and coherent manner. Course Outcomes At the end of this course, students will be able to: <ol style="list-style-type: none"> 1. Students should be able to learn the cost concepts in decision making 2. Student should be able to do cost planning and Marginal Costing 3. Students should be able to create a database for operational control and decision making. 							

UNIT-I

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

UNIT-II

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

UNIT-III

Cost Behavior and Profit Planning Marginal Costing: Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.

Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.

UNIT-IV

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

UNIT-V

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

Suggested Readings:

1. Cost Accounting – A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

Course Code	Course Title				Core/Elective		
OE 9102 CS	Business Analytics				Open Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- Understand the role of business analytics within an organization
- Analyse data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making
- To become familiar with processes needed to develop, report, and analyse business data
- Use decision-making tools/Operations research techniques
- Manage business process using analytical and management tools
- Analyse and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.
- Student will able to understand the basic rules of research formulation and procedure for obtaining patent rights

Course Outcomes

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

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

UNIT-I

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.

Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT-II

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

UNIT-III

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-IV

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT-V

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without 8 Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Recent Trends in Embedded and collaborative business intelligence, Visual data 4 recovery, Data Storytelling and Data journalism.

Suggested Readings:

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

Course Code	Course Title				Core/Elective		
OE 9103 EC	Embedded System Design				Open Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- Detailed overview of important concepts of Embedded system
- Analyse PIC microcontroller, its features and programming
- Describe ARM Microcontroller architectural details and instruction set
- Understand ARM Memory management
- Learn the techniques to develop an embedded system and case studies

Course Outcomes

After completing this course, the student will be able to:

1. Understand the fundamentals of the embedded system design
2. Enumerate the instruction set of ARM Processor by studying the architecture of ARM core
3. Acquire knowledge on the serial, parallel and network communication protocols.
4. Learn the embedded system design life cycle and co-design issues.
5. List the various embedded software development tools used in the design of embedded system for various applications.

UNIT I

Introduction to Embedded Systems: Overview of Embedded System Architecture, Challenges & Trends of Embedded Systems, Hardware Architecture, Software Architecture. Application areas of Embedded Systems and Categories of Embedded Systems. Embedded System Design and Co-Design issues and Design Cycle Process

UNIT II

PIC 18: Family Overview, Architecture, Instruction Set, Addressing modes. Timers, interrupts of PIC 18, Capture/Compare and PWM modules of PIC 18

UNIT III

ARM Architecture: ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families. Instruction Set: Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions.

UNIT IV

ARM Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instruction Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions. Exception and interrupt handling.

ARM Memory Management: Cache Architecture, Policies, Flushing and Caches, MMU, Page Tables, Translation Access Permissions, Context Switch.

UNIT V

Embedded Software Development Tools, Host and Target Machines, Linkers/Locators for Embedded Software, Getting Embedded Software into the Target System. Debugging Techniques.

Case Studies: Design of Embedded Systems using Microcontrollers – for applications in the area of communications and automotives. (GSM/GPRS, CAN, Zigbee)

Suggested Readings:

1. Raj Kamal, Embedded Systems – Architecture, Programming and Design, 2nd Edition, TMH, 2008.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, ARM Systems Developer's Guides – Designing & Optimizing System Software, Elsevier, 2008.
3. Mazidi, MCKinlay and Danny Causey, PIC Microcontrollers and Embedded Systems, Pearson Education, 2007
4. David.E. Simon, An Embedded Software Primer, 1st Edition, Pearson Education, 1999
5. Jonathan W. Valvano, Embedded Microcomputer Systems, Real Time Interfacing, Thomas Learning, 1999.

Course Code	Course Title				Core/Elective		
OE 9104 EE	Waste to Energy				Open Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
Course Objectives ➤ To enable students to aware about the generation of energy from the waste.							
Course Outcomes At the end of this course, students will be able to:							
1. Students should able to learn the Classification of waste as a fuel. 2. Students should able to learn the Manufacture of charcoal. 3. Students should able to carry out the designing of gasifiers and biomass stoves. 4. Student should able to learn the Biogas plant technology.							

UNIT-I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors. Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-II

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

UNIT-III

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

UNIT-IV

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction

UNIT-V

Biochemical conversion: Anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Suggested Readings:

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

Course Code	Course Title				Core/Elective		
OE 9105 ME	Industrial Safety				Open Elective		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ Causes for industrial accidents and preventive steps to be taken. ➤ Fundamental concepts of Maintenance Engineering. ➤ About wear and corrosion along with preventive steps to be taken ➤ The basic concepts and importance of fault tracing. ➤ The steps involved in carrying out periodic and preventive maintenance of various equipments used in industry <p>Course Outcomes</p> <p>After completing this course, the student will be equipped with:</p> <ol style="list-style-type: none"> 1. concepts of engineering systems safety 2. Identify the causes for industrial accidents and suggest preventive measures. 3. Identify the basic tools and requirements of different maintenance procedures. 4. Apply different techniques to reduce and prevent Wear and corrosion in Industry. 5. Identify different types of faults present in various equipments like machine tools, IC Engines, boilers etc. 6. Apply periodic and preventive maintenance techniques as required for industrial equipments like motors, pumps and air compressors and machine tools etc. 							

UNIT-I

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

UNIT-II

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

UNIT-III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Aircompressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Suggested Readings:

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

Course Code	Course Title				Core/Elective		
AD 9001 HS	English for Research Paper Writing				Audit I		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	-
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ Understand that how to improve your writing skills and level of readability ➤ Understand the nuances of language and vocabulary in writing a Research Paper. ➤ Develop the content, structure and format of writing a research paper. ➤ Produce original research papers without plagiarism <p>Course Outcomes</p> <p>After completing this course, the student will be able to:</p> <ol style="list-style-type: none"> 1. Interpret the nuances of research paper writing. 2. Differentiate the research paper format and citation of sources. 3. To review the research papers and articles in a scientific manner. 4. Avoid plagiarism and be able to develop their writing skills in presenting the research work. 5. Create a research paper and acquire the knowledge of how and where to publish their original research papers. 							

UNIT - I

Academic Writing: Meaning & Definition of a research paper– Purpose of a research paper – Scope – Benefits, Limitations – outcomes.

UNIT - II

Research Paper Format: Title – Abstract – Introduction – Discussion – Findings, Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

UNIT - III

Research Methodology: Methods (Qualitative – Quantitative) Review of Literature. Criticizing, Paraphrasing & Plagiarism.

UNIT - IV

Process of Writing a research paper: Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft –Revising/Editing - The final draft and proof reading.

UNIT - V

Research Paper Publication: Reputed Journals – National/International – ISSN No, No. of volumes, Scopus Index/UGC Journals – Free publications - Paid Journal publications – Advantages/Benefits

Presentation Skills: Developing Persuasive Presentations, Structure of Presentation, Presentation Slides, Presentation Delivery, role of the audience, what to search and cite, how to establish credibility.

Suggested Readings:

1. C. R Kothari, Gaurav, Garg, —Research Methodology Methods and Techniques, 4/e, New Age International Publishers.
2. Day R, —How to Write and Publish a Scientific Paper”, Cambridge University Press, 2006
3. MLA Hand book for writers of Research Papers, 7/e, East West Press Pvt. Ltd, New Delhi
4. Lauri Rozakis, Schaum’s, Quick Guide to Writing Great Research Papers, Tata McGraw Hills Pvt. Ltd, New Delhi.

Course Code	Course Title				Core/Elective		
AD 9002 CE	Disaster Management				Audit I		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	-
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters ➤ To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters ➤ To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc. <p>Course Outcomes</p> <p>At the end of this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response. 2. Critically evaluate disaster risk reduction and humanitarian response policy and Practice from multiple perspectives. 3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations. 4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in. 							

UNIT-I

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

UNIT-II

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

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

UNIT-III

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

UNIT-IV

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

UNIT-IV

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Readings:

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

Course Code	Course Title				Core/Elective		
AD 9003 HS	Sanskrit for Technical Knowledge				Audit I		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	-

Course Objectives

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
- To explore the huge knowledge from ancient Indian literature

Course Outcomes

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

1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

UNIT-I

Introduction to Sanskrit Language: Sanskrit Alphabets-vowels-consonants- significance of Amarakosa-parts of Speech-Morphology-creation of new words-significance of synonyms-sandhi-samasa-sutras-active and passive Voice-Past/Present/Future Tense-Syntax-Simple Sentences (elementary treatment only)

UNIT-II

Role of Sanskrit in Basic Sciences: Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba, sutram or baudhayana theorem (origination of Pythagoras theorem)-value of pie-Madhava's sine and cosine theory (origination of Taylor's series).

The measurement system-time-mass-length-temp, Matter elasticity-optics-speed of light (origination of Michaelson and Morley theory).

UNIT-III

Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and Electronics Engineering):

Building construction-soil testing-mortar-town planning-Machine definition-crucible-furnace-air blower-Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-Pingala chandasutram (origination of digital logic system)

UNIT-IV

Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology):

Computer languages and the Sanskrit languages-computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

UNIT-V

Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering): Classification of plants- plants, the living-plants have senses-classification of living creatures, Chemical laboratory location and layout- equipment-distillation vessel-kosthi yanthram

Suggested Readings:

1. M Krishnamachariar, History of Classical Sanskrit Literature, TTD Press, 1937.
2. M.R. Kale, A Higher Sanskrit Grammar: For the Use of School and College Students, Motilal Banarsidass Publishers, 2015.
3. Kapail Kapoor, Language, Linguistics and Literature: The Indian Perspective, ISBN- 10: 8171880649, 1994.
4. Pride of India, Samskrita Bharati Publisher, ISBN: 81-87276 27-4, 2007.
5. Shri Rama Verma, Vedas the source of ultimate science, Nag publishers, 2005.

Course Code	Course Title				Core/Elective		
AD 9004 HS	Value Education				Audit I		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	-
Course Objectives <ul style="list-style-type: none"> ➤ Understand the need and importance of Values for self-development and for National development. ➤ Imbibe good human values and Morals ➤ Cultivate individual and National character. Course Outcomes <p>After completion of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Gain necessary Knowledge for self-development 2. Learn the importance of Human values and their application in day to day professional life. 3. Appreciate the need and importance of interpersonal skills for successful career and social life 4. Emphasize the role of personal and social responsibility of an individual for all-round growth. 5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood. 							

UNIT-I

Human Values, Ethics and Morals: Concept of Values, Indian concept of humanism, human values; Values for self-development, Social values, individual attitudes; Work ethics, moral and non-moral behaviour, standards and principles based on religion, culture and tradition.

UNIT-II

Value Cultivation, and Self-management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT-III

Spiritual outlook and social values: Personality and Behavior, Scientific attitude and Spiritual (soul) outlook; Cultivation of Social Values Such as Positive Thinking, Punctuality, Love & Kindness, avoiding fault finding in others, Reduction of anger, forgiveness, Dignity of labour, True friendship, Universal brotherhood and religious tolerance.

UNIT-IV

Values in Holy Books: Self-management and Good health; internal & external cleanliness, Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT-V

Dharma, Karma and Guna: Concept of soul; Science of Reincarnation, Character and Conduct, Concept of Dharma; Cause and Effect based Karma Theory; The qualities of Devine and Devilish; Satwic, Rajasic and Tamasic gunas.

Suggested Readings:

1. Chakroborty, S.K., Values & Ethics for organizations Theory and practice, Oxford University Press, New Delhi, 1998.
2. Jaya Dayal Goyandaka, Srimad Bhagavad Gita with Sanskrit Text, Word Meaning and Prose Meaning, Gita Press, Gorakhpur, 2017.

Course Code	Course Title				Core/Elective		
AD 9011 HS	Constitution of India and Fundamental Rights				Audit II		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	-
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism. <p>Course Outcomes</p> <p>At the end of this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics. 2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India. 3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution. 4. Discuss the passage of the Hindu Code Bill of 1956. 							

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Suggested Readings:

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.

Course Code	Course Title				Core/Elective		
AD 9012 HS	Pedagogy Studies				Audit II		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	-
<p>Course Objectives</p> <ul style="list-style-type: none"> ➤ To present the basic concepts of design and policies of pedagogy studies. ➤ To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices. ➤ To familiarize various theories of learning and their connection to teaching practice. ➤ To create awareness about the practices followed by DFID, other agencies and other researchers. ➤ To provide understanding of critical evidence gaps that guides the professional development <p>Course Outcomes</p> <p>At the end of this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms. 2. Examine the effectiveness of pedagogical practices. 3. Understand the concept, characteristics and types of educational research and perspectives of research. 4. Describe the role of classroom practices, curriculum and barriers to learning. 5. Understand Research gaps and learn the future directions. 							

UNIT-I

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

UNIT-II

Thematic Overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education

UNIT-III

Evidence on the Effectiveness of Pedagogical Practices: Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches – Teachers attitudes and beliefs and pedagogic strategies.

UNIT-IV

Professional Development: alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT-V

Research Gaps and Future Directions: Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.

Suggested Readings:

1. Ackers J, Hardman F, Classroom Interaction in Kenyan Primary Schools, *Compare*, 31 (2): 245 – 261, 2001.
2. Agarwal M, Curricular Reform in Schools: The importance of evaluation, *Journal of Curriculum Studies*, 36 (3): 361 – 379, 2004.
3. Akyeampong K, Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER), Country Report 1. London: DFID, 2003.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J, Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count? *International Journal Educational Development*, 33 (3): 272- 282, 2013.
5. Alexander R J, *Culture and Pedagogy: International Comparisons in Primary Education*, Oxford and Boston: Blackwell, 2001.
6. Chavan M, *Read India: A mass scale, rapid, learning to read campaign*, 2003.

Course Code	Course Title				Core/Elective		
AD 9013 HS	Stress Management by Yoga				Audit II		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	-
<p>Course Objectives The Course will introduce the students to</p> <ul style="list-style-type: none"> ➤ Creating awareness about different types of stress and the role of yoga in the management of stress. ➤ Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual). ➤ Prevention of stress related health problems by yoga practice. <p>Course Outcomes After successful completion of the course, the students will be able to:</p> <ol style="list-style-type: none"> 1. Understand yoga and its benefits. 2. Enhance Physical strength and flexibility. 3. Learn to relax and focus. 4. Relieve physical and mental tension through asanas. 5. Improve work performance and efficiency. 							

UNIT - I

Meaning and Definition of Yoga - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

UNIT - II

Meaning and Definition of Stress - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

UNIT - III

Concept of Stress According to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress

UNIT - IV

Asanas- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar.

UNIT - V

Pranayama- Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

Meditation Techniques: Om Meditation - Cyclic meditation: Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

Suggested Readings:

1. "Yogic Asanas for Group Training - Part-I", Janardhan Swami Yogabhyasi Mandal, Nagpur.
2. Swami Vivekananda, "Rajayoga or Conquering the Internal Nature", Advaita Ashrama (Publication Department), Kolkata.
3. Nagendra H.R and Nagaratna R, "Yoga Perspective in Stress Management", Swami Vivekananda Yoga Prakashan, Bangalore.

Course Code	Course Title				Core/Elective		
AD 9014 HS	Personality Development Through Life Enlightenment Skills				Audit II		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	-
Course Objectives <ul style="list-style-type: none"> ➤ To learn to achieve the highest goal happily ➤ To become a person with stable mind, pleasing personality and determination ➤ To awaken wisdom in students Course Outcomes <p>At the end of this course, students will be able to:</p> <ol style="list-style-type: none"> 1. Develop their personality and achieve their highest goal of life. 2. Lead the nation and mankind to peace and prosperity. 3. Practice emotional self-regulation. 4. Develop a positive approach to work and duties. 5. Develop a versatile personality. 							

UNIT - I

Neetisatakam – Holistic Development of Personality - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

UNIT - II

Neetisatakam – Holistic Development of Personality (cont'd) - Verses 52, 53, 59 (don'ts) - Verses 71,73,75 & 78 (do's) - Approach to day to day works and duties.

UNIT - III

Introduction to Bhagavadgeetha for Personality Development - Shrimad Bhagavadgeetha: Chapter 2 – Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 –Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

UNIT - IV

Statements of Basic Knowledge - Shrimad Bhagavadgeetha: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad Bhagawat Geeta.

UNIT - V

Role of Bhagavadgeetha in the Present Scenario - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

Suggested Readings:

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

Online Resources: NTPEL: <http://nptel.ac.in/downloads/109104115/>

Course Code	Course Title				Core/Elective		
PC 3151 DS	Embedded Systems Lab				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	50	-	1

Course Outcomes

After completing this course, the student will be able to:

1. Write assembly language programming to perform different arithmetic, logic, looping and branching operations on 8051 Microcontroller.
2. Interface different programmable devices to 8051 Microcontroller and control them by writing the assembly language programming.
3. Interface different programmable devices to ARM Microcontroller and control them by writing embedded C programming.

PART -A**Microcontroller & Interfacing Programs**

1. Simple Assembly Language Programs for:
 - a. Addition/Subtraction/Multiplication/Division.
 - b. Addressing modes and Interrupts.
 - c. Loops & Branches.
2. Assembly Language programs to configure and control general purpose I/O (GPIO) port pins.
3. Assembly Language programs for interfacing DAC to generate different waveforms.
4. Assembly Language programs for interfacing traffic light control at a junction.
5. Assembly Language programs for interfacing stepper motor and to control it.
6. Assembly Language programs to read digital values from external peripherals and execute them with the Target board.
7. Program for reading and writing of a file.
8. Program to demonstrate Time delay Program using built in Timer/Counter feature on IDE environment.

PART -B**Interfacing Experiments using Arm Development Board**

1. Programs to interface 8-Bit LED and control them.
2. Program to implement Buzzer interface on IDE environment.
3. Program to display message in a 2 line x 16 characters LCD display.
4. Stepper motor interface to ARM development boards & control it.
5. DAC interface to ARM development boards for the generation of different waveforms.
6. ADC & Temperature sensor LM35 interface to ARM development boards.
7. Transmission from kit and reception from PC using serial port.
8. Timer operations in different modes.

Note:

- i. Minimum of 10 experiments has to be performed with 5 from each part.
- ii. The above listed programs are to be implemented on 8051 architecture based Microcontroller & ARM based processors/Equivalent development boards.
- iii. Kiel Microcontrollers Development tool or Equivalent simulation software should be used.

Course Code	Course Title				Core/Elective		
PC 3152 DS	Digital Systems Design Lab				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	50	-	1
Course Outcomes After completing this course, the student will be able to: <ol style="list-style-type: none"> Design Verilog HDL codes for combinational and sequential circuits. Design and implement of digital designs on FPGA. 							

List of Experiments:

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

Course Code	Course Title				Core/Elective		
PC 3153 DS	DSP Lab				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	50	-	1
Course Outcomes							
After completing this course, the student will be able to:							
<ol style="list-style-type: none"> 1. Design IIR, and FIR filters for band pass, band stop, low pass and high pass filters 2. Design multi rate signal processing of signals through systems. 3. Compile and solve the digital signal processing problems using DSK and CCS 							

PART-A (Experiments using MATLAB or equivalent)

1. DFT and FFT algorithm.
2. Linear and circular Convolutions.
3. FIR filter design using different data windows.
4. IIR filter design: Butterworth and Chebyshev.
5. Implementation of multi-rate systems.

PART-B (Experiments on DSK and CCS)

1. Impulse Response.
2. Convolution & Correlation.
3. FFT (DIT, DIF) and Bit Reversal Operation
4. FFT and its Applications
5. Design of FIR filters using windows
6. Design of IIR filters.
7. Audio Codec and its Applications
8. Real Time Data Exchange
9. Modulation schemes (FM, AM)
10. Voice scrambler- application of low pass filtering and AM modulation

Note:

- i. Part-A, experiments can be performed in MATLAB with different toolboxes like Signal Processing, Signal Processing block set, and SIMULINK/ MATHEMATICA/ any popular software can be used.
- ii. Part-B Experiments can be performed on TMS320c6713 DSK processor kit and CC Studio
- iii. A total of 12 experiments to be completed during the semester

Course Code	Course Title					Core/Elective	
PC 3154 DS	Seminar					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	50	-	1
Course Outcomes At the end of this course, students will be able to: <ol style="list-style-type: none"> 1. Develop the habit of referring the journals for literature review. 2. Understand the gist of the research paper. 3. Identify the potential for further scope. 4. Present the work in an efficient manner. 5. Write the documentation in standard format. 							

Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Each student is required to:

1. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10 minutes.
2. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the Department.

Guidelines for awarding marks		
S. No.	Description	Max. Marks
1	Contents and relevance	10
2	Presentation skills	10
3	Preparation of PPT slides	05
4	Questions and answers	05
5	Report in a prescribed format	20

Note:

1. The seminar presentation should be a gist of at least five research papers from **Peer-reviewed** or **UGC recognised** journals.
2. **The seminar report should be in the following order:** Background of work, literature review, techniques used, prospective deliverables, discussion on results, conclusions, critical appraisal and reference.
3. At least two faculty members will be associated with the seminar presentation to evaluate and award marks.
4. Attendance of all the students for weekly seminar presentations is compulsory. If the student fails to secure minimum attendance as per O.U. rules, the marks awarded in the seminar presentation shall remain void.

Course Code	Course Title				Core/Elective		
PC 3155 DS	Mini Project with Seminar				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	4	50	-	2

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

1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained
5. Write the documentation in standard format

Guidelines:

- As part of the curriculum in the II- semester of the programme each student shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
- Each student will be allotted to a faculty supervisor for mentoring.
- Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
- Mini projects shall have inter-disciplinary/ industry relevance.
- The students can select a mathematical modeling based/Experimental investigations or Numerical modeling
- All the investigations should be clearly stated and documented with the reasons/explanations.
- The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and reference

Departmental committee: Supervisor and a minimum of two faculty members

Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 50		
Evaluation by	Max. Marks	Evaluation Criteria / Parameter
Supervisor	20	Progress and Review
	05	Report
Departmental Committee	05	Relevance of the Topic
	05	PPT Preparation
	05	Presentation
	05	Question and Answers
	05	Report Preparation

Course Code	Course Title				Core/Elective		
PC 3156 DS	Major Project Phase – I				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	20	100	-	10

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

1. Exposed to self-learning various topics.
2. Learn to survey the literature such as books, journals and contact resource persons for the selected topic of research.
3. Learn to write technical reports.
4. Develop oral and written communication skills to present.
5. Defend their work in front of technically qualified audience

Guidelines:

- The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
- Seminar should be based on the area in which the candidate has undertaken the dissertation work.
- The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
- The preliminary results (if available) of the problem may also be discussed in the report.
- The work has to be presented in front of the committee consists of Chairperson-BoS, Osmania University and Head, Supervisor & Project coordinator from the respective Department of the Institute.
- The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 100		
Evaluation by	Max. Marks	Evaluation Criteria / Parameter
Supervisor	30	Project Status / Review(s)
	20	Report
Departmental Committee (Chairperson BoS, Osmania University and Head, Supervisor & Project coordinator from the respective department of the institution)	10	Relevance of the Topic
	10	PPT Preparation
	10	Presentation
	10	Question and Answers
	10	Report Preparation

Note: The Supervisor has to assess the progress of the student regularly.

Course Code	Course Title					Core/Elective	
PC 3157 DS	Major Project Phase – II (Dissertation)					Core	
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	32	-	200	16

Course Outcomes

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

1. Use different experimental techniques and will be able to use different software/ computational /analytical tools.
2. Design and develop an experimental set up/ equipment/test rig.
3. Conduct tests on existing set ups/equipments and draw logical conclusions from the results after analysing them.
4. Either work in a research environment or in an industrial environment.
5. Conversant with technical report writing and will be able to present and convince their topic of study to the engineering community.

Guidelines:

- It is a continuation of Major Project Phase – I started in semester - III.
- The student has to submit the report in prescribed format and also present a seminar.
- The dissertation should be presented in standard format as provided by the department.
- The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
- The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner and Chairperson BoS, & Head, Osmania University and Supervisor from the Institute.
- The candidate has to be in regular contact with his/her Supervisor / Co-Supervisor

Guidelines for awarding marks in SEE (Semester End Examination): Max. Marks: 200		
Evaluation by	Max. Marks	Evaluation Criteria / Parameter
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	30	Quality of the work which may lead to publications
	10	Analytical / Programming / Experimental Skills Preparation
	10	Report preparation in a standard format
External Examiner and Chairperson, BoS & Head, Osmania University (All together)	20	Power Point Presentation
	60	Quality of thesis and evaluation
	30	Innovations, application to society and Scope for future study
	20	Viva-Voce