Department of Electronics and Telecommunication Engineering

M. Tech Electronics (Digital System) Engineering

Syllabus

2015-16

K. E. Societies
Rajarambapu Institute of Technology
(An Autonomous Institute Affiliated to Shivaji University)
<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Teaching Scheme</th>
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<tr>
<td>EDS5011</td>
<td>Digital VLSI Design</td>
<td>3</td>
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<td>EDS5031</td>
<td>Advanced Digital Signal</td>
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<td>Embedded System Design</td>
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<td>EDS5071</td>
<td>Research Methodology</td>
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<td>Program Elective-1</td>
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<td>EDS5071</td>
<td>Digital VLSI Design Lab</td>
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<td>EDS5019</td>
<td>Advanced Digital Signal</td>
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<td>EDS5021</td>
<td>Embedded System Lab</td>
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<td>EDS5023</td>
<td>Seminar</td>
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<td>EDS5024</td>
<td>Research Methodology Lab</td>
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<tr>
<td>EDS5027</td>
<td>Proficiency in Technical</td>
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Total Credits: 24, Total Contact Hours/Week: 29

Implemented from year 2015-16
## Rajarambapu Institute of Technology, Rajaramnagar.

(An Autonomous Institute)

### First Year M. Tech. Electronics (Digital System) Engineering

#### Syllabus Structure

#### Semester II

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<td>EDS5021</td>
<td>Digital System Design using HDL</td>
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<td>EDS5041</td>
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<td>EDS50201</td>
<td>VLSI Signal Processing Lab</td>
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<td>EDS50221</td>
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<td>EDS50241</td>
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Total Credits: 24, Total Contact Hours/Week: 27

Implemented from year 2015-16
First Year M. Tech. Electronics (Digital System) Engineering
Syllabus Structure
Semester I
Program Elective-I

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<th>Course Code</th>
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<tr>
<td>PEE5091</td>
<td>Electromagnetic Compatibility and Interference</td>
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<td>PED5111</td>
<td>Synthesis and Optimization of Digital Circuits</td>
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First Year M. Tech. Electronics (Digital System) Engineering
Syllabus Structure
Semester II
Program Elective-II

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<td>PEE5061</td>
<td>Hardware Software Co-design</td>
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<tr>
<td>PEE5081</td>
<td>Biomedical Signal Processing</td>
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<tr>
<td>PEE5101</td>
<td>Embedded Software and RTOS</td>
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COURSE DESCRIPTION:

CMOS has become increasingly attractive as a basic integrated circuit technology due to its low power (at moderate frequencies), good scalability, and rail-to-rail operation. There are now a variety of CMOS circuit styles, some based on static complementary conductance properties, but others borrowing from earlier NMOS techniques and the advantages of using clocking disciplines for pre-charge-evaluate sequencing. MOSFET, basic circuit building blocks are described, leading to a broad view of both combinatorial and sequential circuits. Including characteristics of interconnect, gate delay, device sizing, I/O buffering and circuit-level and layout design optimization.

In digital IC design a large digital IC is formed by interconnecting basic building blocks (Small number of basic digital circuits are used as basic building blocks). The inverter is one of the most fundamental basic building blocks. The design & analysis of MOS inverter can be directly applied to the more complex circuits.

COURSE OUTCOMES:

After successful completion of this course students should be able to:

1. Complete a significant VLSI design flow having a set of objective criteria and design constraints & describe the general steps required for processing of CMOS integrated circuits.

2. Create models of moderately sized CMOS circuits that realize specified digital functions & have an understanding of the characteristics of CMOS circuit construction.

3. Estimate and optimize interconnect delay and noise.

4. Design chip including characteristics of interconnect, gate delay, device sizing, I/O buffering and circuit-level and layout design optimization.
5. Introduce the concepts and techniques of modern integrated circuit design and testing (CMOS VLSI) using Computer Aided Design (CAD) Tool i.e. Tanner

PREREQUISITE:
Student should have knowledge of electronics & digital design.

UNIT I
INTRODUCTION TO CMOS: Why Study CMOS?, Basic Concepts, Switch Logic, Logic Transmission, Data Storage, Dynamic CMOS, CMOS System Design, MOSFET Characteristics, Threshold Voltage, Current-Voltage Characteristics, p-Channel MOSFETs, MOSFET Capacitances, Junction Leakage Currents, Parasitic Resistances,

UNIT II
INVERTER: CMOS Inverter Operation, Design techniques, Inverter Switching Characteristics, Output Capacitance, Secondary Parasitic Effects, Cascaded inverter & super buffer, Power dissipation, The Power-Delay Product, Temperature Dependence,

UNIT III
STATIC COMBINATIONAL LOGIC DESIGN: Static CMOS logic gate design, Pseudo nMOS gates, Pass transistor logic, CMOS Transmission Gates, Transmission Gate Model, Tristate buffers

UNIT IV
SEQUENTIAL LOGIC CIRCUITS: Types of regenerative circuits, Basic s-R Flip flop/latch, clocked JK Latch, D latch, Timing parameters for sequential circuits, Clock skew, Static Vs Dynamic latch, CMOS Latch a clock skew free latch

Implemented from year 2015-16
UNIT V
ANALOG VLSI- MOS diode, MOS resistor, Introduction to switches, Register emulation using switched capacitor circuits, Current sink & Sources, Current Mirrors, Differential amplifiers Offset voltage in MOS differential amplifiers

UNIT VI
ANALOG CIRCUITS: Operational amplifier, Low Voltage Filters, Comparators, Introduction to switched capacitors, Data conversion circuits, Phase locked loop circuits.

TEXT BOOK:
1. Principles of CMOS VLSI Design, Version 1.0, by N. Weste
2. VLSI Design & EDA Tools by Angsuman Sarkar Scitech publications (India) Pvt. Ltd

REFERENCE BOOK:
1. CIRCUIT DESIGN for CMOS VLSI by John P. Uyemura Georgia Institute of Technology Springer Science + Business Media, LLC
COURSE DESCRIPTION:
Advances in integrated circuit technology have had a major impact on the technical areas to which digital signal processing techniques and hardware are being applied. The efficient use of such hardware devices requires thorough understanding of various digital signal processing techniques. These techniques encompass filter design methods, power spectrum estimation and sampling rate conversion. The subject is essential for anyone whose work is concerned with signal processing applications.

COURSE OUTCOMES:
After successful completion of this course students should be able to;
1. Explain techniques available for implementation of digital signal processing system
2. Design and simulate the working of given digital signal processing system
3. Evaluate performance of digital signal processing system
4. Interpret the performance of digital signal processing system
5. Write limitations of digital signal processing system designed with specific technique.

PREREQUISITE:
Students should have knowledge of signals & systems & digital signal processing.

UNIT I
LINEAR PHASE FIR FILTER: Properties of FIR filter, window design technique, FIR filter design by frequency sampling method, Optimum equiripple linear phase FIR filters. FIR differentiator, Hilbert transformers, Comparison of design methods for linear phase FIR filters.
UNIT II

POWER SPECTRUM ESTIMATION: Estimation of spectra from finite duration observation of signals, Computation of energy density function, Estimation of auto-correlation and power spectrum of random signals; the periodogram. The use of the DFT in power spectrum estimation, Parametric methods for power spectrum estimation: ARMA, AR, MA

UNIT III

OPTIMAL FILTERS-I: Autocorrelation, cross correlation, applications of optimal filters, problem statement of optimal filter, signal models, Signal modelling: Pade approximation, Prony’s method, Shank’s method, Inverse filter

UNIT IV

LINEAR PREDICTION: Forward and backward linear prediction, The Levinson Durbin algorithm, The Schur algorithm

UNIT V

ADAPTIVE FILTERS: Necessity, Adaptive filters as noise cancellers; Configuration of adaptive filters; main components of adaptive filters; Adaptive algorithms: LMS, RLS;

UNIT VI

MULTIRATE DSP: Decimation by a factor of D, Interpolation by factor of I, sampling rate conversion by a rational factor I/D, filter design & Implementation of sampling rate conversion

REFERENCE BOOKS:


Implemented from year 2015-16
5. Introduction to digital signal processing, Johnny R Johnson, PRENTICE HALL OF INDIA, 1st edition
COURSE DESCRIPTION:
This course will familiarize students with the fundamentals of embedded system hardware and firmware design. The IA32 microprocessor will be also studied. The architecture and instruction set of the microcontroller will be discussed & programming will be learned by students to develop systems. Students will familiarize with fundamentals of Linux, installation & configuration. Also, the concepts of embedded security will be explored.

COURSE OUTCOMES:
After successful completion of this course students should be able to:

1. The student will show understanding of Embedded System
2. The student will exhibit the knowledge of design metrics of Embedded systems
3. The student will understand Linux operating system and device driver
4. The student will demonstrate the knowledge of android operating system

PREREQUISITE:
Students should have knowledge of digital electronics, knowledge of microprocessor, microcontrollers, and C programming.

UNIT I
INTRODUCTION TO EMBEDDED SYSTEMS:
Introduction to Embedded Systems, Architecture of Embedded System, Design Methodology, Design Metrics, General Purpose Processor, System On chip. Embedded system design and Implemented from year 2015-16

UNIT II

EMBEDDED PROCESSOR ARCHITECTURE.

UNIT III

HARDWARE INTERFACING GPIO.
Serial, Interfacing to sensors and actuators, USB extender, Operating System Overview. Multi Threading, Pipes, Semaphore, Mutex, message passing. Linux Kernel overview, kernel module programming.

UNIT IV

EMBEDDED LINUX AND DEVICE DRIVER
Introduction to Embedded Linux, Linux kernel: construction, Kernel Build system, kernel configuration, obtaining custom Linux kernel, Kernel initialization, Porting Linux on ARM9. Device driver: Concepts, Module utilities, Driver methods, Device driver for LED, Keyboard, LCD.

Implemented from year 2015-16
UNIT V
LINUX INSTALLATION AND CONFIGURATION AND SECURITY,
Linux Boot process, RAM disk, Boot loaders, UEFI BusyBox, Programming on Linux platform,
Audio signal Processing, Video signal Processing Network connectivity, Socket programming,
Command Line tools, Shell commands

UNIT VI
INTRODUCTION TO SHELL SCRIPTING,
Tools for programming make, gdb, gcc, serial port programming, Hardware Interfacing GPIO,
Serial, Interfacing to sensors and actuators, USB extender, Introduction to HTML, JavaScript,
Python

REFERENCES:
   Dreamtech Publication.
2. Embedded System Design: A unified Hardware/Software Introduction, Frank Vahid, and
   Tony Givargis, Wiley Publication.
   Mc Graw Hill
4. An Embedded Software Primer, David E. Simon, Pearson Education Publication
5. The Linux Programming Interface: A Linux and UNIX System Programming Handbook
   By Michael Kerrisk
7. Linux Kernel Development By Robert Love
8. Embedded Linux primer, second edition, Christopher Hallinan, Pearson publication

Implemented from year 2015-16
COURSE DESCRIPTION:
This course is designed for students pursuing the M. Tech Electronics PG programme. It is designed on the principles and concept of experimental design, data collected from such experiments and data analyses. The course will also introduce students to the use of statistical methods too.

PREREQUISITES: Nil

COURSE OUTCOMES:
After completion of the course, the students should be able to;
1. demonstrate the knowledge of research process
2. apply statistical methods for analyzing the data and interpret results
3. use research related softwares for analyzing the data
4. illustrate the Intellectual Property rights

UNIT I
INTRODUCTION TO RESEARCH: Definitions and characteristics of research; Types of research; Main components of any research work. Topic Selection: Learning Objectives; Problem identification; Criteria for prioritizing problems for research.

UNIT II
FORMULATING THE PROBLEM STATEMENT, LITERATURE REVIEW: Uses of literature review; Source of information; Organization of information; Formulation of the research objectives.

Implemented from year 2015-16
UNIT III

RESEARCH METHODOLOGIES: Study population; Variables; Sampling; Sample size determination; Plan for data collection; Methods of data collection; Plan for data processing and analysis; Ethical considerations.

UNIT IV

WORK PLAN; Major components and outline of the different phases in a research process: Summary of the major components of a research proposal; Fieldwork; Writing a research report, Thesis writing, presentation and editing tools. Data analysis software-SPSS, Core calculation software, Introduction to C and MATLAB, open source softwares.

REFERENCES:

COURSE DESCRIPTION:
Electromagnetic Compatibility & Interference is offered as the open elective course at the second semester of Electronics Engineering post-graduate programme; consist of two modules. The first module constitutes the study of sources of electromagnetic interference, requirement of electromagnetic compatibility, spectra of digital waveform, radiated emission and susceptibility models. The second module constitutes the study of nonideal behavior of passive components, electromagnetic shielding, coupling modeling, conducted emission measurement and special considerations in electronic system design to satisfy Electromagnetic Compatibility requirements.

The prerequisite for this course is good background of Electromagnetic Engineering and signals and systems courses offered at the undergraduate programme. Students should have clear understanding of the boundary conditions, Maxwell’s equations, and transmission line analysis and Fourier transform analysis.

This course intends to build the competency in the students to understand basics of electromagnetic interference and compatibility requirements of electronic products.

COURSE OUTCOMES:
After successful completion of this course students should be able to;

1. Understand sources of electromagnetic interference and requirement of electromagnetic compatibility.
2. Analyze spectra of digital waveform and discuss signal integrity
3. Understand models and effects of radiated, conducted emissions and radiated conducted susceptibility on electronic system.

Implemented from year 2015-16
4. Describe non-ideal behavior of passive components at high frequencies.

5. Apply methods to minimize intersystem and intra-system interference to satisfy electromagnetic compatibility requirements.

PREREQUISITE:
Students should have good knowledge of electromagnetic engineering course offered at UG level.

UNIT I
06

UNIT II
07

UNIT III
06

Implemented from year 2015-16
UNIT IV

UNIT V
ELECTROMAGNETIC SHIELDING AND COUPLING BETWEEN DEVICES:
Introduction, Shielding Effectiveness, Near Field Illumination, Electric And Magnetic Sources, Se Expressions: Near Zone Considerations, Coupling Between Devices: Capacitive (Electric) Coupling, Magnetic (Inductive) Coupling.

UNIT VI
CONDUCTED EMISSION AND SYSTEM DESIGN FOR EMC: Conducted Emissions and Susceptibility, Measurement of Conducted Emissions, The Line Impedance Stabilization Network (LISN), Power supply filters, power supply and filter placement, ground concept, and printed circuit board design.

REFERENCE BOOKS:
COURSE DESCRIPTION:
To learn about state-of-the-art techniques and algorithms for synthesis and optimization of digital systems. Topics in synthesis cover high-level and architectural synthesis, decision and word-level diagrams, combinational logic optimization, and sequential optimization and testing.

COURSE OUTCOME:
After successful completion of this course students should be able to;
1. Describe fundamentals of synthesis and optimization techniques.
2. Illustrate various algorithms and optimization techniques to optimize digital circuits/modules.
3. Model digital systems by using various hardware modeling languages
4. Test variety of digital circuits by using different testing simulators/techniques.
5. Synthesize various digital circuits using different synthesis and optimization techniques.

PREREQUISITE: Basic logic design hardware design and organization and introduction to HDL language.

UNIT I
INTRODUCTION: Microelectronics, semiconductor technologies and circuit taxonomy, Microelectronic design styles, computer aided synthesis and optimization.
GRAPHS: Notation, undirected graphs, directed graphs, combinatorial optimization, Algorithms, tractable and intractable problems, algorithms for linear and integer programs, graph optimization problems and algorithms, Boolean algebra and Applications.

Implemented from year 2015-16
UNIT II

HARDWARE MODELING

Hardware Modeling Languages, distinctive features, structural hardware language, Behavioral hardware language, HDLs used in synthesis, abstract models, structures logic networks, state diagrams, dataflow and sequencing graphs, compilation and optimization techniques.

UNIT III

TWO LEVEL COMBINATIONAL LOGIC OPTIMIZATION

Logic optimization, principles, operation on two level logic covers, algorithms for logic minimization, symbolic minimization and encoding property, minimization of Boolean relations.

SEQUENTIAL CIRCUIT OPTIMIZATION

Sequential circuit optimization using state based models, sequential circuit optimization using network models.

UNIT IV

SCHEDULE ALGORITHMS:

A model for scheduling problems, Scheduling with resource and without resource constraints, Scheduling algorithms for extended sequencing models, Scheduling Pipe lined circuits.

UNIT V

CELL LIBRARY BINDING

Problem formulation and analysis, algorithms for library binding, specific problems and algorithms for library binding (lookup table F.P.G.As and Anti fuse based F.P.G.As), rule based library binding.

UNIT VI

TESTING

Simulation, Types of simulators, basic components of a simulator, fault simulation Techniques, stuck-at- zero, stuck-at-one, Automatic test pattern generation methods(ATPG), design for Testability (DFT) Techniques.

Implemented from year 2015-16
Reference Books:
Rajarambapu Institute of Technology, Rajaramnagar.
(An Autonomous Institute)

First Year M. Tech. Electronics (Digital System) Engineering
SEM-I
EDS50171 DIGITAL VLSI DESIGN LAB

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COURSE DESCRIPTION:

This course focuses on design of VLSI using Tanner Tool. Digital VLSI design lab deals with designing of inverters, current sources, differential amplifier & registers. Tanner tool covers use of simulation software’s for digital VLSI design.

PREREQUISITE:

- Student should have knowledge of VLSI.

COURSE OUTCOMES:

After completion of this course students will be able to:

1. Design & implement digital VLSI circuits using Tanner tools.
2. Interpret the art of digital VLSI design by Tanner tools.
4. Design the real time digital system applications by coding, simulating and synthesis.

NMOS INVERTER

Depletion and Enhancement Mode Circuit Simulation and Adjustment of Vth VLSI Vm parameters for NMOS inverter.

CMOS INVERTER

Circuit Simulation, adjustment of W / L ratio of P & N channel MOS transistor for symmetrical drive output and loading consideration. Scaling of CMOS Inverter for different technologies, study of secondary effects (temperature, power supply and process corners). Layout of CMOS Inverter, Extraction of parasitics and back annotation and related modifications in circuit parameters and layout.

Implemented from year 2015-16
CURRENT SOURCE / MIRROR
Circuit simulation of current Mirror using BJT and MOS (Simple, Wilson and Widlar configurations) study and modifications to improve power and load regulation. Layout of CMOS Current Mirror.

8 BIT SHIFT REGISTER CELL
Building of cell Library of logic gates and flip flops and building of 8 bit shift register from the same. Optimization of the same from layout and power considerations.

DIFFERENTIAL AMPLIFIER
Study of specifications of Differential amplifier and Design considerations. Study of input loading and biasing techniques
COURSE DESCRIPTION:
Advances in integrated circuit technology have had a major impact on the technical areas to which digital signal processing techniques and hardware are being applied. The efficient use of such hardware devices requires thorough understanding of various digital signal processing techniques. These techniques encompass filter design methods, sampling rate conversion and power spectrum estimation. The subject is essential for anyone whose work is concerned with signal processing applications.

COURSE OUTCOMES:
After completion of this course students will be able to:
1. Present and Write laboratory reports in desired format in grammatically correct language
2. Write limitations of digital signal processing system designed with specific technique
3. Design and simulate the working of given digital signal processing system
4. Evaluate performance of digital signal processing system
5. Interpret the performance of digital signal processing system

PREREQUISITE:
Students should have knowledge of MATLAB programming.

Implemented from year 2015-16
PRACTICAL LIST:

Student should perform minimum 10 experiments

1. Design and implementation of window based filters
2. Design and implementation of filters using frequency sampling
3. Design and implementation of equiripple filters
4. Signal modeling using Pade approximation
5. Signal modeling using Prony’s method
6. Signal modeling using Shank’s method
7. Design and implementation of forward predictor
8. Design and implementation of backward predictor
9. Design and implementation of Interpolator
10. Design and implementation of Decimator
11. Design and implementation of sampling rate converter by arbitrary factor
12. Signal decomposition and reconstruction with HARR wavelet using standard equation
13. Signal decomposition and reconstruction with HARR wavelet using MATRIX method
14. Signal decomposition and reconstruction with Daubechies wavelet using standard equation
15. Signal decomposition and reconstruction with Daubechies wavelet using MATRIX method
16. Estimate spectrum of energy signal
17. Estimate spectrum of power signal
18. Implementation of adaptive filters
COURSE DESCRIPTION:
This course will familiarize students with the fundamentals of embedded system hardware and firmware design. The 1A32 microprocessor will be also studied. The architecture and instruction set of the microcontroller will be discussed & programming will be learned by students to develop systems. Students will familiarize with fundamentals of linux, Installation & configuration. Also the concepts of embedded security will be explored.

COURSE OUTCOMES:
After completion of this course students will be able to:
1. Understand of Embedded System
2. Exhibit the knowledge of design metrics of Embedded systems
3. Understand Linux operating system and device driver
4. Demonstrate the knowledge of android operating system

PREREQUISITE:
Student should have basic knowledge operating systems.

Laboratory Assignments/Experiments: (based on Linux Operating system):
1. Write a program for 4x4 Matrix Keypad Interface.
2. Study of Linux Kernel.
3. Write a device driver for LCD.
4. Study of Android operating system.

Implemented from year 2015-16
5. Write a program for I2C based ADC.
6. C for GPIO and serial interfacing
7. Python accumulation processing and plotting of data
8. Introduction to HTML, JavaScript
9. Hardware interface to various peripherals.
10. Compilation of BusyBox for small memory requirements (newlib, uclibc)
11. Application development on Linux platform
12. Code optimization for Audio Video signal processing
14. Bootloader configuration, creation of RAM disk.
15. Handling multi-threading use of Pipes, semaphoresinux kernel structure
16. Linux kernel module programming.
First Year M. Tech. Electronics (Digital System) Engineering
SEM-I
EDS50231 SEMINAR

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The credits will be based on the delivery of the seminars on the advanced and emerging fields of Electronics.
COURSE DESCRIPTION:
This course is designed for students pursuing the M. Tech Electronics PG Programme. It is designed on the principles and concept of experimental design, data collected from such experiments and data analyses. The course will also introduce students to the use of statistical methods too.

PREREQUISITES: Nil

COURSE OUTCOMES:

After completion of the course, the students should be able to:
1. demonstrate the knowledge of research process
2. apply statistical methods for analyzing the data and interpret results
3. use research related software’s for analyzing the data
4. Explain ethical issues pertaining to academic research.
5. Write research proposals, articles to publish his/her work.

EXPERIMENT LIST:
1. Problem identification
2. Literature Review
3. Research Design
4. Data Collection
5. Data Analysis
6. Interpretation of Data
7. Research Report Writing

implemented from year 2015-16
8. Thesis Writing and presentation
9. Study of research related software (e.g. SPSS)
10. Study of IPR
11. Plagiarism Testing
12. Proposal writing
COURSE DESCRIPTION:
To demonstrate knowledge and skills to formulate various types of business and technical communication. To analyze rhetorical aspects of audience, purpose, and context of technical information to effectively communicate through written, oral, and visual media.

COURSE OUTCOMES:
After successful completion of this course students should be able to:
1. Prepare documents that are structurally and technically appropriate.
2. Enhance writing skills with clarity, conciseness, coherence, cohesion, and emphasis.
3. Develop strategies for any Communication to address diverse forums.
4. Learn to Listen actively and Efficiently
5. Enhance Inter-personnel interaction & interviewing techniques

PREREQUISITE:

UNIT I

LANGUAGE FOR TECHNICAL PURPOSE AND PRESENTATION TOOLS: Technical vocabulary, Sentence structures, Microsoft office, Graphical presentations

UNIT II

FORMAL WRITTEN COMMUNICATION:
Drafting Letters, e-Mails, Memos, Notices, Circulars, Schedules
UNIT III
PROJECT AND RESEARCH PROPOSALS:
What's a research proposal? Essentials, Abstract, Aims, Background & significance, Design & methods, Writing a sample proposal.

UNIT IV
PROJECT REPORTS:
Types of reports, Planning a report, Collection & organization of information, Structure & style, Proofreading etc. Writing a sample report

UNIT V
TEAM BUILDING AND WORKING IN GROUPS:
Need of team, Effective teams, Group development, Roles in group, Case studies.

UNIT VI
LEADERSHIP SKILLS:
Leadership quality and styles, Emotional intelligence, Diplomacy and Tact and effective communication, Case studies.

UNIT VII
BUSINESS MEETINGS:
Understanding role of meetings, planning meetings, developing meeting agendas, scheduling meetings, conducting meetings effectively, Taking notes and publishing minutes and concluding meetings, action plans, Demo meetings.

UNIT VIII
PRESENTATION SKILLS:
Preparation, Understanding audience, Use of presentation tools, Presentation, nonverbal techniques, handling questions, Demo presentations.

Implemented from year 2015-16
REFERENCES BOOKS: