**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**
**PROGRAMME: Electronics and Communication Engineering**
**COURSE: EC-501 Voice Communication**

| Category of course | Course Title | Course code | Credit-4C | | | Theory paper (ES) |
|---|---|---|---|---|---|---|
| Departmental Core (DC-6) | Voice Communication | EC-501 | L<br>3 | T<br>1 | P<br>0 | Max. Marks-100<br>Min. Marks: 35<br>Duration: 3 hrs. |

## Course Contents

**Unit I**

**Basic Telephony :** Introduction, standard telephone set, function, local loop, block diagram, basic call procedure, call progress tones and signals, cordless telephones, caller identification, electronic telephones, telephone circuit - local subscriber loop, channel noise and units of power measurements, transmission parameters, voice frequency circuit arrangements, crosstalk.

**Unit II**

**Public telephone network:** Introduction, transmission system environment, public telephone network, instruments, local loops, trunk circuits, telephone exchanges - local exchanges, automated central office switches and exchanges, telephone numbering plan, telephone services, telephone switching hierarchy, common channel signaling system-evolution of SS7, signaling points, call setup, Multiplexing of telephone channels - frequency division multiplexing, FDM hierarchy, composite base-band signals, formation of groups, super groups, master groups and radio channel, wavelength division multiplexing.

**Traffic analysis:** traffic characterization and measurement, arrival and holding time distributions, loss systems, lost call estimation, network blocking probabilities.

**Unit III**

**Digital telephony:** Introduction, advantages and disadvantages of digital voice network, voice digitization, time division multiplexing of PCM signals, digital carrier, Super-frame TDM format, Fractional T Carrier Service, Digital hierarchy, Master Group and Commercial TV, Picture Phone Terminal, Data Terminal, Digital Carrier Line Encoding, Duty Cycle, Bandwidth Requirement, Clock and Framing Bit Recovery, Error Detection, T Carrier System, T-1 Carrier System, , Statistical TDM, Codec and Combo Chips.

**Unit IV**

**Digital transmission:** Introduction, digital data and digital signal, pulse transmission, inter-symbol, interference, synchronous and asynchronous transmission, line coding – level encoding, bipolar coding, Code Space redundancy, N zero substitution, Pair Selected ternary, Ternary coding, digital bi-phase, differential encoding, coded mark inversion, multilevel signaling, partial response signaling, error performance, performance monitoring, time division multiplexing - Bit vs Word Interleaving, framing, TDM loops and rings.

**Unit V**

**Digital switching:** Switching function, space division switching, multistage switching, non-blocking switches, blocking probabilities, four wire switches, switch matrix control, time division switching – analog and digital, two dimensional switching, multi stage time and space switching, STS and TST switching, digital cross connect systems, digital switching in analog environment.

**References:**


1. W. Tomasi: Advanced Electronic Communication Systems, 6th Edition, PHI
2. W. Tomasi: Electronic Communication Systems, Pearson Education
3. John C.Bellamy: Digital Telephony, 3rd Edition, Willey India Pvt. Limited
4. T. Vishwanathan: Telecommunication Switching Systems and Networks, PHI.
5. James Martin: Telecommunication and Computers, PHI
6. G. F. Snyder: Introduction to Telecommunication Networks, Vikas Publishing House.
7. Cole Marion: Introduction to Telecommunication, Pearson Education.

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**
**PROGRAMME: Electronics and Communication Engineering**
**COURSE: EC-502 Electromagnetic Theory**

| Category of course | Course Title | Course code | Credit-4C | | | Theory paper (ES) |
|---|---|---|---|---|---|---|
| Departmental Core (DC-7) | Electromagnetic Theory | EC-502 | L<br>3 | T<br>1 | P<br>0 | Max. Marks-100<br>Min. Marks: 35<br>Duration: 3 hrs. |

## Course Contents

**Unit I**

Cartesian, cylindrical and spherical co-ordinate systems, scalar and vector fields, gradient, divergence and curl of a vector field, Divergence theorem and Stokes's theorem, concept of vectors.

Electrostatic Fields – Coulomb's law, electric field intensity due to different charge distribution viz. line charge, sheet charge, Field due to continuous volume – electric potential, properties of potential function, potential gradient equipotential surfaces, line of force, Gauss law, applications of Gauss law, Gauss law in point form method of images.

**Unit II**

Laplace's and Poisson's equations, solution of Laplace's equation. Electric dipole, dipole moment, potential and electric field intensity due to dipole. Behavior of conductors in an electric field. Conductor and insulator, electric field inside a dielectric, polarization. Boundary value conditions for electric Field. Capacitance and Capacitances of various types of capacitors. Energy stored and energy density in static electric field. Current density, conduction and convection current density, Ohms law in point form, equation of continuity.

**Unit III**

Static Magnetic Field, Biot-Savart's law, Magnetic Field intensity due to straight current carrying filament, circular, square and solenoidal current carrying wire. Relationship between magnetic flux, flux density and magnetic field intensity.

Ampere's circuital law and its applications, magnetic field intensity due to infinite sheet and various other configurations, Ampere's circuital law in point form.

Magnetic force, moving charge in a magnetic field, Lorentz force on straight and long current carrying conductors in magnetic field, force between two long and parallel current carrying conductors. Magnetic dipole and dipole moment, a differential current loop as dipole, torque on a current carrying loop in magnetic field, magnetic boundary conditions.

**Unit IV**

Scalar magnetic potential and its limitations, Vector magnetic potential and its properties, vector magnetic potential due to different simple configurations**;**

Self and Mutual inductances, determination of self and mutual inductances, self inductance of solenoid, toroid coils, mutual inductance between a straight long wire and a square loop. Energy stored in magnetic Field and energy density.

Faraday's Law, transformer and motional EMF equations. Displacement current, Maxwell's equations as generalization of circuit equations, Maxwell's equation in free space, Maxwell's equation for harmonically varying field, static and steady fields. Maxwell's equations in differential and integral form.

**Unit V**

**Electro Magnetic Waves:** Uniform plane wave in time domain in free space, Sinusoidally time varying uniform plane wave in free space, Wave equation and solution for various medium, Uniform plane wave in dielectrics and conductors.

Poynting Vector theorem, instantaneous, average and complex poynting vector, power loss in a plane conductor, energy storage.

Polarisation of waves. Reflection by conductors and dielectric – Normal and Oblique incidence. Reflection at surface of a conducting medium, surface impedance, transmission line analogy.

**References:**


1. Mathew N.O Sadiku: Elements of Electromagnetic, Oxford.
2. N.N. Rao: Element of Engineering Electromagnetic, Pearson Education.
3. William H. Hayt: Engineering Electromagnetic, TMH.
4. John D. Kraus: Electromagnetics, Mc. Graw Hill.
5. Jordan Balmian: Electromagnetic wave and Radiating System, PHI.
6. David K. Cheng: Electromagnetic Fields and Wave, Addison Wesley.
7. Ramo, Whinnerry and VanDuzzer " Fields and waves in communication electronics ", Wiley 1984
8. Harrington RF, "Electromagnetic fields" Mc Graw Hill

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**
**PROGRAMME: Electronics and Telecommunication Engineering**
**COURSE: EC-503 Digital Communication**

| Category of course | Course Title | Course code | Credit-6C | | | Theory paper (ES) |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| Departmental Core (DC-8) | Digital Communication | EC- 503 | 3 | 1 | 2 | Max. Marks-100<br>Min. Marks: 35<br>Duration: 3 hrs. |

## Course Contents

**Unit-I**
**Random Processes**
**Random variables:-** Cumulative distribution function, Probability density function, Mean, Variance and standard deviations of random variable, Gaussian distribution, Error function, Correlation and autocorrelation, Central-limit theorem, Error probability, Power Spectral density of digital data.

**Unit-II**
**Pulse Modulation**
**Analog Signals:-** Sampling of Signal, Sampling Theorem for Low Pass and Band Pass Signals, Aliasing, Pulse Amplitude Modulation (PAM), Time Division Multiplexing (TDM), Channel Bandwidth for PAM-TDM Signal, Types of Sampling, Instantaneous, Natural and Flat Top (Mathematical and Spectral Analysis), Aperture Effect, Introduction to Pulse Position and Pulse Duration Modulation.

**Unit-III**
**Pulse Code Modulation**
**Digital Signal:-** Quantization, Quantization Error, Pulse Code Modulation (PCM), Signal-to-Noise Ratio in PCM, Companding, Data Rate and Bandwidth of Multiplexed PCM Signal, Inter-symbol Interference, Differential PCM (DPCM), Delta Modulation (DM), and Adaptive Delta Modulation (ADM), Comparison of various system in terms of Bandwidth and Signal-to-Noise Ratio.

**Unit-IV**
**Digital Modulation Techniques :-** Analysis, Generation and Detection (Block Diagram), Spectrum and Bandwidth of Amplitude Shift Keying (ASK), Binary Phase Shift Keying (BPSK), Differential Phase Shift Keying (DPSK), Offset and Non-offset Quadrature Phase Shift Keying (QPSK), M-ary PSK, Binary Frequency Shift Keying (BFSK), M-ary FSK, Minimum Shift Keying, Quadrature Amplitude Modulation (QAM), Comparison of digital modulation techniques on the basis of probability of error, Matched Filter.

**Unit–V**
**Spread Spectrum Modulation**
Introduction to Spread Spectrum modulation, Generation and Characteristics of p-n Sequences, Direct sequence Spread Spectrum System, Spread Spectrum with Code division Multiple Access (CDMA), Frequency Hopping Spread Spectrum.

**References:**

1. Taub and Schilling: Principles of Communication System, TMH
2. Simon Haykins: Communication Systems, 4th Edition, John Wiley.
3. Singh and Sapre: Communication System, TMH
4. B.P. Lathi: Modern Analog and Digital Communication System, Oxford University Press
5. Tomasi: Advanced Electronics Communication Systems, 6th Edition, PHI
6. Couch: Digital and Analog Communication, Pearson Education.
7. David Smith : Digital Transmission Systems, Springer- Macmillan India Ltd


**List of Experiments:**

**Simulation of different modulation techniques using Scilab (Freeware-Downloadable from** www.Scilab.org**) /Matlab/Any Similar Software. Plotting of signal constellation diagrams and signals (modulated/ unmodulated). Calculation of Bit error rates BER and comparison of various modulation techniques.**

1. Study of Sampling Process and Signal Reconstruction and Aliasing.
2. Study of PAM, PPM and PDM.
3. Study of PCM Transmitter and Receiver.
4. Time Division Multiplexing (TDM) and Demultiplexing.
5. Study of ASK, PSK and FSK Transmitter and Receiver.

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**
**PROGRAMME: Electronics and Communication Engineering**
**COURSE: EC-504 Microprocessor, Microcontroller and Embedded Systems**

| Category of course | Course Title | Course code | Credit-6C | | | Theory paper (ES) |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| Departmental Core (DC-9) | Microprocessor, Microcontroller and Embedded Systems | EC- 504 | 3 | 1 | 2 | Max. Marks-100<br>Min. Marks: 35<br>Duration: 3 hrs. |

## Course Contents

**Unit -I**

**Microprocessor 8086 Architecture** - BIU and EU, Registers, Pin Diagram, Memory Addressing, Clock Generator 8284, Buffers and Latches, Maximum and Minimum Modes.

**Unit -II**

**Addressing Modes**, Instruction set of 8086, Assembly Language Programming, Assemblers, Procedures, Macros, Interrupts, 8086 Based Multiprocessor Systems - Coprocessors (8087 NDP), Closely and Loosely Coupled Multiprocessor Systems (8089 IOP).

**Unit -III**

**Interfacing Chips-** IC 8155 (Static Ram with I/O Ports and Timer), 8755 (EPROM with I/O Ports), 8251A (USART), 8255A (Programmable Peripheral Interface), 8253/8254 (Programmable Interval Timer/Counter), 8257 (DMA Controller), 8259A (Programmable Interrupt Controller).

**Unit -IV**

**Microcontrollers** - Microcontroller 8051- Architecture, Pin Diagram, I/O Ports, Internal RAM and Registers, Interrupts, Addressing Modes, Memory Organization and External Addressing, Instruction Set, Assembly Language Programming, Real Time Applications of Microcontroller- Interfacing with LCD, ADC, DAC, Stepper Motor, Key Board and Sensors.

**Unit -V**

**Embedded Systems**-Introduction, Classification, Processors, Hardware Units, Software Embedded into System, Applications and Products of Embedded Systems, Structural Units in Processor, Memory Devices, I/O Devices, Buses, Interfacing of Processor Memory and I/O Devices, Case Study of an Embedded System for a Smart Card.

**References:**


1. B. B. Brey: The Intel Microprocessors, Architecture, Programming and Interfacing, Pearson Education.
2. Liu Gibson: Microcomputer Systems: The 8086/8088 Family- Architecture, Programming and Design , PHI
3. D. V. Hall: Microprocessors and Interfacing, TMH.
4. Mazidi and Mazidi: The 8051 Microcontroller and Embedded Systems, Pearson Education.
5. Ayala Kenneth:- The 8051 microcontroller, Third Edition, Cengage Learning
6. A. V. Deshmukh: Microcontroller (Theory and Application), TMH.
7. Raj Kamal: Embedded Systems- Architecture, Programming and Design, TMH, New Delhi.
8. V. Udayashankara and M. S. Mallikarjunaswamy: 8051 Microcontroller, TMH, New Delhi.


**List of Experiments:**

1. Assembly Language Programs of Microprocessor 8086,
2. Assembly Language Programs of Microcontroller 8051.
3. Assembly Language Programs for Interfacing Chips.

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**
**PROGRAMME: Electronics and Telecommunication**
**COURSE: EC-505 CMOS VLSI Design**

| Category Course | Course Title | Course Code | Credit-6C | | | Theory Paper (ES) |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| Departmental Core (DC-10) | CMOS VLSI Design | EC-505 | 3 | 1 | 2 | Max. Marks-100<br>Min. Marks: 35<br>Duration: 3 Hrs. |

## Course Contents

**Unit -I**
**Introduction**
**CMOS Logic:** Inverter, NAND Gate, Combinational Logic, NOR Gate, Compound Gates, Pass Transistors and Transmission Gates, Tristates, Multiplexers, Latches and Flip-Flops, CMOS Fabrication and Layout: Inverter Cross-section, Fabrication Process, Layout Design rules, Gate Layout, Stick Diagrams. VLSI Design Flow.
**MOS Transistor Theory**: Ideal I-V Characteristics, C-V Characteristics: MOS Capacitance Models, MOS Gate Capacitance Model, MOS Diffusion Capacitance Model. Non ideal I-V Effects: Velocity Saturation and Mobility Degradation, Channel Length Modulation, Body Effect, Subthreshold Conduction, Junction Leakage, Tunneling, Temp. and Geometry Dependence. DC Transfer characteristics: Complementary CMOS Inverter DC Characteristics, Beta Ratio Effects, Noise Margin, Ratioed Inverter Transfer Function, Pass Transistor DC Characteristics, Tristate Inverter, Switch- Level RC Delay Models.

**Unit -II**
**CMOS Processing Technology**
CMOS Technologies: Background, Wafer Formation, Photolithography, Well and Channel Formation, Silicon Dioxide ($SiO_2$), Isolation, Gate Oxide, Gate and Source/Drain Formation, Contacts and Metallization, Passivation, Metrology. Layout Design Rules: Design Rules Background, Scribe Line and Other Structures, MOSIS Scalable CMOS Design Rules, Micron Design Rules. CMOS Process Enhancements: Transistors, Interconnect, Circuit Elements, Beyond Conventional CMOS.

**Unit -III**
**Circuit Characterization and Performance Estimation**
Delay Estimation: RC Delay Models, Linear Delay Model, Logical Effort, Parasitic Delay. Logical Effort and Transistor Sizing: Delay in a Logic Gate, Delay in Multistage Logic Networks, choosing the Best Number of Stages. Power Dissipation: Static Dissipation, Dynamic Dissipation, Low-Power Design. Interconnect: Resistance, Capacitance, Delay, Crosstalk. Design Margin: Supply Voltage, Temperature, Process Variation, Design Corners. Reliability, Scaling.

**Unit -IV**
**Analog Circuits**
MOS Small-signal Model, Common Source Amplifier, The CMOS Inverter as an Amplifier, Current Mirrors, Differential Pairs, Simple CMOS Operational Amplifier, Digital to Analog Converters, Analog to Digital Converters, RF Circuits.

**Unit -V**
**Combinational Circuit Design**
Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Differential Circuits, Sense Amplifier Circuits, BiCMOS Circuits, Low Power Logic Design, Comparison of Circuit Families. Standard Cell Design: Cell Hierarchies, Cell Libraries, Library Entries, Cell Shapes and Floor Planning.

**References:**

1. Neil H.E. Weste, David Harris, Ayan Banerjee: CMOS VLSI Design, Third Edition, Pearson Education.
2. Neil H.E. Weste, Kamran Eshraghian: Principle of CMOS VLSI Design, Pearson Education.
3. J. P. Uyemura: Chip Design for Submicron VLSI, Cengage Learning.
4. Philip E. Allen and Douglas R Holberg: CMOS Analog Circuit Design, Oxford
5. Carver Mead and Lynn Conway: Introduction to VLSI systems, BS Publication.
6. J. P. Uyemura: Introduction to VLSI Circuits and Systems, Wiley.
7. Plummer: Silicon VLSI Technology, Pearson Education.


**List of Experiments:**
1. Design of MOS Generator Using any Electronic Design Automation (EDA)- eg. Microwind / Cadence / Sylvaco / Tanner silicon HiPer / Xilinx ISE 9i or any similar software
2. DC MOSFET Curves using EDA.

3. Design of CMOS Logic Gates using EDA.
4. Draw the following CMOS circuits using 0.12 µm and 65 nm technology and simulate for transfer characteristics along with 2D and 3D view from $45^0$ angles. Compare power consumption and rise/fall delays in both technologies:
    a. CMOS Inverter with 0.1pF and 0.1fF capacitance loads, in both cases with equal rise and fall times. Plot output eye diagram also.
    b. CMOS NAND and NOR gates with 0.01pF load and equal rise and fall times. Comment on area requirement of both gates.
5. To design Current Mirror using CMOS 0.18 micron Technology.
6. Design a basic differential amplifier circuit using current mirror logic. Show gain of amplifier and comment on bandwidth.
7. Design the Schmitt trigger circuit with UTP= 4.5 V and LTP = 2.0 V. Plot transfer curve analysis (with hysteresis effect) $V_O$ versus $V_I$.
8. Design a 2-bit parallel adder from schematic and its CMOS layout. List global delay of all nodes. Identify the critical path and comment on its optimization.

**RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL**
**PROGRAMME: Electronics and Telecommunication**
**COURSE: EC-506 Software Lab-II- Hardware Description Languages**

| Category Course | Course Title | Course Code | Credit-4C | | | Practical Exam |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| IT-4 | Software Lab-II | EC-506 | 0 | 0 | 4 | Max. Marks-50 |

## Course Contents

### SECTION A: ELECTRONIC DESIGN AUTOMATION SOFTWARE

Introduction to EDA environment, eg. Microwind / Cadence / Sylvaco / Tanner silicon HiPer / Xilinx ISE 9i / any similar software / Any Freeware - EDA, its study and simulation/analysis/design of circuits. (The EDA tool package should have equal number of perpetual licenses for all modules and should have GUI)

### SECTION B: VERILOG

Introduction, Language Element, Expression, Gate Level Modeling, User-Defined Primitives, Data Flow Modeling, Behavioral Modeling, Structural Modeling, Synthesize, Verilog Constructs To G
ate, Modeling- Combinational Logic, Modeling-Sequential Logic, Modeling A Memory.

### SECTION C: VHDL

Introduction, Entity Declaration, Architecture Body, Configuration and Package Declaration, Package Body, Model Analysis, Simulation, Basic Language Elements, Behavioral Modeling, Data Flow Modeling, Structural Modeling.

**References:**


1. J. Bhasker: A Verilog HDL Primer, New Edition, Pearson Education.
2. J. Bhasker: A Verilog HDL Synthesis, BS Publication.
3. D. L. Perry: VHDL: Programming by Example, TMH.
4. V. A. Pedroni: Circuit Design with VHDL, PHI.
5. J. R. Armstrong and F. G. Gray: VHDL Design Representation and Synthesis, Pearson Education.
6. Palnitkar: VHDL, Pearson Education.
7. Software Manuals.


**List of Experiments:**

**Section A: Study and Experiments based on EDA environment**.
**Section B and C:Simulation of Following Using Verilog/VHDL**.

1. Half Adder, Full Adder, Subtractor, Flip-Flop's, 4-bit Comparators
2. Multiplexers - 2:1, 4:1 and 8:1
3. Parity Generator.
4. 4 Bit Up/Down Counter with Loadable Count.
5. Decoders –
6. 2:4, 3:8 and 4:16.
7. 8-bit Shift Resistors.
8. Barauel Shifter.
9. Design of 8-bit Arithmetic unit.
10. N by M Binary Multiplier.