RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Choice Based Credit System

Biomedical Engineering, IV-Semester

Digital Circuits & Systems

Course Objective:

1. To have the basic knowledge of number system & Boolean algebra.
2. To give knowledge of basic concept of computer and memory system.
3. To understand the working of Digital circuits & system
4. To develop skills for implementation of digital circuits system.

Course Outcome:

1. Students will be able to represent numerical values in various number systems and Boolean algebra
2. Learners will able to analyze and design digital combinational circuits and sequential digital circuits
3. Learners have the knowledge of the nomenclature and technology in the area of memory devices: ROM, RAM, PROM, PLD, FPGAs, etc.
4. Understand the importance and need for verification, testing of digital logic and design for testability.
5. Learners will have the skills to implement digital circuits in real time system.

COURSE CONTENTS

Introduction

Digital Systems; Data representation and coding; Logic circuits, integrated circuits; Analysis, design and implementation of digital systems.

Number Systems and Codes

Positional number system; Binary, octal and hexadecimal number systems; Methods of base conversions; Binary, octal and hexadecimal arithmetic; Representation of signed numbers; Fixed and floating point numbers; Binary coded decimal codes; Gray codes; Error detection and correction codes - parity check codes and Hamming code.

Combinatorial Logic Systems - Definition and specification; Truth table; Basic logic operation and logic gates.

Boolean Algebra and Switching Functions - Basic postulates and fundamental theorems of Boolean algebra; Standard representation of logic functions - SOP and POS forms; Simplification of switching functions - K-map and Quine-McCluskey tabular methods; Synthesis of combinational logic circuits.

Combinational Logic Modules and their applications
Decoders, encoders, multiplexers, demultiplexers and their applications; Parity circuits and comparators; Arithmetic modules- adders, subtractors and ALU; Design examples.

Sequential Logic systems:
Definition of state machines, state machine as a sequential controller; Basic sequential circuits- latches and flip-flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip-flop; Timing hazards and races; Analysis of state machines using D flip-flops and JK flip-flops; Design of state machines - state table, state assignment, transition/excitation table, excitation maps and equations, logic realization; Design examples

Sequential logic modules and their applications
Multi-bit latches and registers, counters, shift register, application examples

Logic families
Introduction to different logic families; Operational characteristics of BJT in saturation and cut-off regions; Operational characteristics of MOSFET as switch; TTL inverter - circuit description and operation; CMOS inverter - circuit description and operation; Structure and operations of TTL and CMOS gates; Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product. Linear wave shaping circuits,

Bistable, monostable & astable multivibrators, Schmitt trigger circuits & Schmitt-Nand gates. Introduction to D/A converters, Various types of Analog & Digital to Analog converters, sample & hold circuits and V-F converters.

Memory
Read-only memory, read/write memory - SRAM and DRAM
Programmable Logic Devices:
PLAs, PALs and their applications; Sequential PLDs and their applications; State-machine design with sequential PLDs; Introduction to field programmable gate arrays (FPGAs)

Reference books:
1. W.H. Gothman, Digital Electronics, PHI Publication.
2. R.J. Tocci, Digital Systems Principles & Applications, TMH Publications.
3. Z. Kohavi, Switching & Automata Theory, TMH Publications.
4. M. Mano, Digital Logic & Computer Design, PHI Publication.
5. H.V. Malmstadt & C.G. Euke (W.A. Benjamin IOC), "Digital Electronics for Scientists".
6. B.S. Sonde, Introduction to System Design using Integrated Circuits, New Age International.
7. Millman & Taub, Pulse, Digital & Switching Waveforms, McGraw Hill.
8. Digital Fundamentals by B. Basavaraj

List of Experiments

1. Study of different Digital IC’s in term of their Technical Specification (pin diagram, applications ,etc)Testing of IC’s by using IC tester.
2. Study of different logic gates and verify their truth table.
3. To Design the basic logic gates using universal gates and verify their truth table.
4. To Design 4-bit two input adder using 7483 IC and verify truth table.
5. To convert the binary code to Gray code using 7486 IC.
6. To study and verify the De Morgans Theorem.
7. To Design the Half Adder using Universal Gates.
8. To Design the Full Adder using Universal Gates.
9. Study of Digital to Analog Converter.
10. To design a 4-bit 2-input Binary Subtraction using IC’s 7483 and 7486.
11. Implementation of the given Boolean function using logic gates in both sop and pos forms.
12. Implementation of 4x1 multiplexer using logic gates.
13. Implementation and verification of decoder/demultiplexer and encoder using logic gates.
14. Verification of state tables of RS, JK, T and D flip-flops using NAND & NOR gates.
15. Design and verify the 4-bit synchronous counter.
16. Design and verify the 4-bit asynchronous counter.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Choice Based Credit System

Biomedical Engineering, IV-Semester

Analog Electronics

Course Objectives:

1. To understand the internal block diagram of operational amplifier and its characteristics both ideal and practical.
2. To illustrate some typical applications of operational amplifiers in linear and non linear modes of operation.
3. To construct various active filter circuits using operational amplifier for various frequency response characteristics.
4. To introduce students the basic theory of power semiconductor devices and passive components, their practical application in power electronics.
5. To familiarize the operation principle of AC-DC, DC-DC, DC-AC conversion circuits and their applications.

Course Outcomes:

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

1. Understand the internal operation of Op-Amp and its specifications.
2. Analyze and design linear applications like adder, substractor, instrumentation amplifier etc. using Op-Amp.
3. Analyze and design non linear applications like timer, comparator etc, using Op-Amp.
4. Classify various active filter configurations based on frequency response and construct using 741 Op-Amp.
5. An ability to understand basic operation of various power semiconductor devices and passive components.
6. An ability to understand the role power electronics play in the improvement of energy usage efficiency.

COURSE CONTENTS

Operational Amplifier Fundamentals

Amplifier Fundamentals, Differential amplifier, Operational Amplifier, Op-Amp Characteristics. Op-Amp in open loop, inverting, non-inverting and differential mode, Practical Op-Amp limitations: D.C. errors, Slew rate, Frequency response, Noise effect, Frequency compensation.

Operational Amplifiers Applications-I

Linear Op-Amp Circuits: Basic Op-Amp Circuits, V-I Converter with floating and grounded load, Current amplifier, Difference amplifier, Instrumentation amplifier,
Non-linear Op-Amp Circuits: Schmitt trigger and applications, Precision rectifiers, Analog switches, Peak detectors, S/H circuits. Comparator, logarithmic amplifiers, Analogue computation, Summer, Average, integrators, differentiators, scaling, multipliers.

Operational Amplifiers Applications-II

Filter specifications, introduction to Butterworth, Chebyshev, inverse Chebyshev approximations and their comparison, first and second order low pass high pass, band pass and band stop filters, switched capacitor filters, 555 timer and its applications. V/F and F/V converters, Multivibrators: Astable, Monostable. Signal Generators: Wien bridge oscillator, Triangular wave generator, Sawtooth wave generator.

Power, Semiconductor Devices

Classification of Power semiconductor devices, characteristics, construction, application and theory of operation of power diode, power transistor, thyristors. Device specifications and ratings, working of Diac, Triac, IGBT, GTO and other power semiconductor devices. Turn-on / Turn-off methods and their circuits.

Rectifiers, Inverters and Choppers

Review of uncontrolled rectification and its limitations, controlled rectifiers, half wave, Full wave configurations, multiphase rectification system, use of flywheel diode in controlled rectifier configurations. Classification of inverters, Transistor inverters, Thyristor inverters, Voltage and Current Communicated inverters, PWM inverters, Principle of Chopper, Chopper classification and types of regulators.

Some Suggested Textbooks/ Reference books:

1. OP-Amps their design and applications-Tobbey et all
2. OP-Amps and Linear Integrated circuit-R.A. Gayakwad (PHI)
3. Integrated Electronics -Millman & Halkias
4. Power Electronics Circuits, devices & applications - M.H. Rashid
5. Power Electronics -P.C.Sen
6. Power Electronics & its applications- Alok Jain, Penram Publication
7. An Introduction Thyristors & their applications - M. Rammurthy

List of experiments:-

1. To obtain the frequency response characteristics of non inverting amplifier using 741 opamp.
2. Design of inverting and non inverting amplifier using 741 opamp for a desired voltage gain and specified input voltage.
3. Design of inverting and non inverting schmitt trigger circuit using 741 opamp.
4. Design of adder and subtractor circuit using 741 opamp.
5. Design of integrating & differentiating circuit using 741 opamp.
6. Design of square wave and triangular wave generator using 741 opamp.
7. To generate a sine wave using 741 opamp by weins bridge circuit.
8. Design of mono stable and astable multivibrator using 741 opamp.

9. To draw the V-I characteristics of S.C.R.
10. To draw the V-I characteristics of DIAC.
11. To draw the V-I characteristics of TRIAC.
12. To study a single phase half wave controlled rectifier and measure the ripple (AC voltage), ripple factor and firing angle.
13. To study single phase center tapped controlled rectifier and measure the firing angle, ripple (AC voltage), ripple factor.
14. To study single phase fully controlled bridge rectifier and measure the firing angle, ripple (AC voltage), ripple factor.

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Choice Based Credit System

Biomedical Engineering, IV-Semester

<u>Clinical Laboratory Equipments</u>

Course Objective:

1. To provide fundamental concepts and methods of various analytical techniques like spectroscopy, chromatography & environmental pollution.
2. To give knowledge of analytical techniques to accurately determine the elements present in the given sample.
3. To enhance the skills for computation of various data.

Course Outcomes:

1. Ability to select Instrument for a particular analysis with come idea of its merits, demerits and limitations
2. Learn will understand specific technique employed for monitoring different pollutants in air and water.
3. Understand the applications and usage of various analytical techniques in real time industrial application.

COURSE CONTENTS

Difference between analytical and other instruments. Gas Analysis: Gas chromatography, Thermal conductivity method, Heat of reaction method. Estimation of oxygen, hydrogen, methane, carbon dioxide, CO, etc. in binary or complex gas mixtures. Zirconia-probe oxygen analyser. Paramagnetic oxygen meters, Electrochemical reaction method.

Ultraviolet and visible photometry spectro : Radiation sources, detectors, read - outmodules, filters, monochromators. Instruments for absorption photometry. Fundamental laws of photometry. Infrared Spectrophotometry : Basic components of IR-spectrophotometers, sample handling, Types of spectrophotometers, Fourier transform infrared spectroscopy.

Mass spectrometry: Basic mass spectrometer, components of mass spectrometers, types of mass spectrometers resolution and applications. X-Ray methods. Production of X-Rays & X-Ray spectra, Instrumental units, Detectors for the measurement of radiation, direct X-Ray methods, X-Ray absorption methods, X-Ray fluorescence methods, X-Ray diffraction, Applications Spectroscopy, ESR Spectroscopy.

Clinical Laboratory Equipments: Measurement of pH value of blood, ESR measurements, Hemoglobin measurement, oxygen and carbon dioxide concentration in blood, GSR measurement, polar graphic measurements, blood cell counter, blood gas analyzer.

Principle of Transmission & Scanning Electron Microscopy, Principle of simple, compound and phase contrast microscopes.

Fundamentals of X-ray generation: Basics of radiography & fluoroscopy system – H/TV chains. Basics of nuclear medicine – radio chemical uses. Nuclear Instruments – detectors and counters.

Reference Books:

1. R.S. Khandpur, “ Hand Book of Biomedical Instrumentation. TMH
2. R.S. Khandpur, “ Analytical & Industrial Instrumentation. TMH
3. Carr J.J., Brown J.M., “ Introduction to Biomedical Equipment Technology” Asea Parson
4. Chromwell, Weibell & Pfeiffer,” Biomedical Instrumentation and Measurements” PHI
5. Togawa, Tamura & Oberg – Biomedical Transducers & Instruments – CRC Press Boca Raton, New York
6. Willard Van, Nostrand, lnstrumental Methods of Analysis
7. Sharma. “Instrumental Methods", S Chand & Co.
8. Geddes & Baker , “Principles of Applied Biomedical Instrumentation” Wiley

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Choice Based Credit System

Biomedical Engineering, IV-Semester

Microprocessors and Interfacing

Course Objective:

1. To introduce fundamental concepts of digital circuits and system to understand why we need microprocessor and memory interfacing devices.
2. The objective of this course is to become familiar with basics of computer, architecture and instruction set of an Intel microprocessor.
3. Developing an Assembly language programming and design the various types of digital and analog interface devices.
4. The accompanying lab is designed to provide practical hands-on experience with microprocessor software applications and interfacing techniques.

Course Outcomes:

1. Understand the concepts of microprocessor and familiar with assembly language programming.
2. Learner will able to utilize instruction set in programming.
3. Ability to interface various devices to the microprocessor.
4. An ability to design and implement a microprocessor based system used in real time system.

COURSE CONTENTS

Introduction to Microprocessor – Architecture & Pin Diagram of typical 8 bit microprocessor-Intel 8085, Study of Functional units, Function & generation of various control signals, Timing Diagrams, Memory Interfacing, Peripheral mapped I/O, Memory Mapped I/O techniques, Interrupts in 8085.

Instruction set of 8085, Types of Instructions, Addressing modes, Programming Techniques of 8085: Counters and Time Delays, Stack and Subroutines, Code Conversion, 16 bit data operations,

Interfacing of 8085 to General purpose programmable peripheral devices- Programmable Peripheral Interface (PPI) 8255, Programmable Interval Timer 8253/8254, Programmable interrupt controller 8259A, DMA controller8257.

Interfacing of 8085 with keyboards, LEDS, ADC, DAC, motors, and stepper motors and Introduction to Programmable keyboard/display interface.
Serial I/O & Data communication, USART (8251), RS 232C, Modems. and various bus standards.

Introduction to the 16-bit 8086 family of microprocessors: Architecture Overview, Memory Organization, Instruction set and Addressing modes of 8086, Minimum and Maximum mode operation of 8086, Assembler Directives and Operators, Elementary 8086 programming.

Reference Books:

1. Microprocessors and Interfacing: R.S.Gaonkar
2. Advanced Microprocessors and Peripherals, A.K.Ray and K.M.Bhurchundi, TMH

List of Experiments:

1. Write a program store 8 bit data in memory.
2. (a)Write a program add two 8 bit numbers.
   (b)Write a program subtract two 8 bit numbers.
3. (a)Write a program add two 16 bit numbers.
   (b)Write a program subtract two 16 bit numbers.
4. Finding's 1's complement of number.
5. Findings 2's complement of number.
6. Write a program Factorial of given numbers.
7. Write a program for Fibonaci series.
8. Write a program for Finite series.
9. (a) Write a program Binary to BCD code conversions.
   (b) Write a program BCD to Binary code conversions.
10. (a) Write a program multiplication of two 8 bit numbers.
    (b) Write a program division of two 8 bit numbers.
11. Write an Assembly language program (ALP) to arrange given 10 numbers in ascending order.
12. Write an Assembly language program (ALP) to count number of 1's (Ones-logic high bits) in a number stored at 2000H.the result must be stored at 2001H.

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Choice Based Credit System

Biomedical Engineering, IV-Semester

Simulation Lab (MATLAB)

1. MATLAB Windows.
2. Elementary Math built in Functions.
3. Arrays, Mathematical Operations with arrays.
4. Matrices, Matrix algebra with MATLAB.
5. Curve Plotting with MATLAB.
6. Control Structures –Conditional statements, loops, Branch control structure.
7. Input/Output Functions.
8. Script Files.
9. Functions and Function files.
10. Cell Arrays, Structure Arrays.
11. Simulink Basics.
12. GUI Basics.

Some Suggested Textbooks/ Reference books:

1. MATLAB Programming for Engineers S.J.Chapman, Thomson Learning
2. MATLAB and its applications in Engineering, R.KBansal, A.K. Goel,M.K.Sharma
3. Programming in MATLAB , M.E. Herniter, Thomson Learning
4. MATLAB - An Introduction with Applications, Amos Gilat ,Wiley India.
5. Essential MATLAB for Engineers and Scientists, B.H.Hahn, D.T.Valentine, Elsevier

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Choice Based Credit System

Biomedical Engineering, IV-Semester

Material Science

Course Objectives:

1. To teach the chemistry and engineering skills needed to solve biomaterials and engineering area.
2. To learn the structure and properties of materials (ceramics, metals, polymers, hydrogels).
3. Various implantable biomaterials and their properties.
4. Interaction of biomaterials to body tissue.

Course Outcome:

1. Student will be able to understand the basic knowledge of biomaterials their properties.
2. Student will be able to analyze various materials according to their properties.
3. Student will be able to differentiate material, use within the body according to body and tissue requirement.
4. Apply their knowledge for design and review papers for scientific research.

COURSE CONTENTS

Definition and classification of biomaterials: Application of polymers, metals, ceramics and composite as biomaterials for implantation. Surface properties of materials physical properties of materials- mechanical properties- viscoelasticity.

Structure of Solids: Crystal structure of solid – crystal imperfections – noncrystalline solid. Strength of biomaterials: Strength and strengthening mechanism of metals, ceramic, glasses and polymers. Structural properties of tissues-Bone, Teeth, Elastic tissue.

Biocompatibility: Definition, Wound healing process- bone healing, tendon healing. Material response: Functions and Degradation of materials In-vivo. Host response: Tissue response to biomaterial, effect of wear particles. Testing of implants: Methods of test for biological performance- In-vitro implant test, In-vivo implant test methods. Qualification implant materials.

Metallic implant materials: Stainless Steel, Co- based alloys, Ti and Ti- based alloys. Ceramic implant materials: Alumminum oxides, Glass ceramic, Carbons. Hard tissue replacement implant: Orthopedic implants, Dental implants. Soft tissue replacement implants: percutaneous and skin implants, vascular implants, heart valve implants.

Polymeric implant materials: Polyolefin’s, polyamides, acrylic polymers, fluorocarbon polymers. Rubbers, Thermoplastics. Physiochemical characteristics of biopolymers. Biodegradable polymers for medical purposes. Synthetic polymeric membrane and their biological applications. Biopolymers in controlled release systems. Artificial skin. Dialysis membrane.

Reference Books:

1. J B Park, "Biomaterials – Science and Engineering", Plenum Press.
2. Jonathan Black, " Biological Performance of materials", Marcel Decker
3. Piskin & A S Hoffmann, "polymeric biomaterials (EDS)", Martinus Nijhoff Publishers
4. Eugene D. Goldbera, "Biomedical Polymers", Akio Nakajima
5. Rembaum & M. Shen "Biomedical Polymers", Mercer Dekkar Inc.
6. Lawrence Stark & Gyan Agrawal, "Biomaterials"
7. L. Hence & E.C Ethridge, "Biomaterials – An interfacial approach.
8. Bhatt, "Biomaterials, Narosa Publication.
9. J B Park, & J D Brnzino "Biomaterials Princile & Application, CRC Press.

Choice Based Credit System

Biomedical Engineering, IV-Semester

Systems Engineering

COURSE OBJECTIVE

This course in systems engineering examines the principles and process of creating effective systems to meet application demands. The course is organized as a progression through the systems engineering processes of analysis, design, implementation, and deployment with consideration of verification and validation throughout.

COURSE CONTENT

What is System Engineering, Origin, Examples of Systems requiring systems engineering,Systems Engineer Career Development Model, Perspectives of Systems Engineering, Systems Domains, Systems Engineering Fields, SystemEngineering Approaches.
Structure of Complex Systems, System Building Blocks and Interfaces, Hierarchy of Complex Systems, System Building Blocks, The System Environment, Interfaces and Interactions, Complexity in Modern Systems.
Concept Development and Exploration, Originating a New System, Operations Analysis, Functional Analysis, Feasibility, System Operational Requirements, Implementation of Concept Exploration.
Engineering Development, Reducing Program Risks, Requirements Analysis, Functional Analysis and Design, Prototype Development as a Risk Mitigation Technique, Development Testing, Risk Reduction.
Integration and Evaluation, Integrating, Testing, And Evaluating The Total System, Test Planning And Preparation, System Integration, Developmental System Testing, Operational Test And Evaluation, Engineering For Production, Transition From Development To Production, Production Operations.

COURSE OUTCOME

After successful completion of the course, students would be able to Plan and manage the systems engineering process and examine systems from many perspectives (such as software, hardware, product, etc.) Students can distinguish critical functions, diagnose problems, and apply descoping strategies and judge the complexity of production and deployment issues.

EVALUATION

Evaluation will be a continuous and integral process comprising classroom and external assessment.

REFERENCES:

1. Alexander Kossiakoff, William N Sweet, “System Engineering Principles and Practice, Wiley India
2. Blanchard Fabrycky, Systems engineering and analysis, Pearson
3. Dennis M. Buede, William D.Miller, “The Engineering Design of Systems: Models & Methods” Wiley India
4. JeffreyL Whitten, Lonnie D Bentley, “System Analysis and Design Methods”
5. Richard Stevens, Peter Brook,” System Engineering – Coping with complexity, Prentice Hall