DEPARTMENT OF VLSI DESIGN AND SYSTEMS ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY KURUKSHETRA
B.Tech. in Microelectronics and VLSI Engineering Programme Scheme

Academic Year 2024-25 onwards

The Course Structure for B. Tech. Programme shall have the following categories of courses:

Sr. No.	Category
1	Institute Core (IC)
2	Non-Conventional Institute Core (NC)
3	Program Core (PC)
4	Program Elective (PE)
5	Open Elective (OE)

Course category explanation

Course category	Explanation
IC	Basic Sciences
	Engineering Arts and Sciences
	Humanities and Social Sciences
PC	Courses specific to the relevant discipline
PE	Elective Courses specific to the relevant discipline
OE	Elective Courses from any domain
NC	Courses only qualifying in nature

Course category summary sheet:

Course Category	**SEMESTER**								**Total Courses**
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
IC	**06**	**05**	**01**	**01**	**-**	**-**	**01**	**–**	**14**
PC	**00**	**01**	**05**	**05**	**04**	**03**	**01**	**01**	**20**
PE	**-**	**-**	**-**	**-**	**01**	**02**	**02**	**01**	**06**
OE	**-**	**-**	**-**	**-**	**01**	**01**	**01**	**01**	**04**
NC	**01**	**01**	**-**	**-**	**-**	**-**	**-**	**-**	**02**
Total Credits	**20**	**21**	**22**	**21**	**22**	**21**	**22**	**17**	**46/166**

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SEMESTER —III

Sr.No	Course Category	Course Title	Course Code	Lecture(L)/ Tutorial(T)/ Practical(P) per week			Credits
				L	T	P	
1	IC	Machine Learning & Data Analytics	CSIC 221	3	0	2	4
2	PC	Electronic Devices and Circuits	MVPC 201	3	0	0	3
3		Digital Design	MVPC 202	3	0	0	3
4		Signals and Systems	MVPC 203	3	0	0	3
5		Data Structure	MVPC 204	3	0	0	3
6		Computer and Processor Architecture	MVPC 205	3	0	0	3
7		Electronics-I Lab	MVPC 206	0	0	2	1
8		Digital Design Lab	MVPC 207	0	0	2	1
9		Programming with MATLAB Lab	MVPC 208	0	0	2	1
10	NC	NCC/ Sports /Yoga	SWNC 101	0	0	4	2*
11	NC	NSS/Club/Technical Societies	SWNC102	0	0	4	
Total							**22**

*Continuous Evaluation Model as per guidelines, and the credit to be awarded at the end of the 6th semester based on Cumulative performance up to the 6th semester.

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SEMESTER —IV

Sr.No	Course Category	Course Title	Course Code	Lecture(L)/ Tutorial(T)/ Practical(P) per week			Credits
				L	T	P	
1	IC	Applied Linear Algebra	MAIC 204	3	0	0	3
2	PC	Analog Electronics	MVPC 209	3	0	0	3
3		Introduction to Communication Engineering	MVPC 210	3	0	0	3
4		Microcontrollers & Embedded System Design	MVPC 211	3	0	0	3
5		Control Systems	MVPC 212	3	0	0	3
6		Electromagnetic Field Theory	MVPC 213	3	0	0	3
7		Electronics-II Lab	MVPC 214	0	0	2	1
8		Communication Lab	MVPC 215	0	0	2	1
9		Microcontrollers and Embedded System Design Lab	MVPC 216	0	0	2	1
10	NC	NCC/ Sports /Yoga	SWNC 101	0	0	4	2*
11	NC	NSS/Club/Technical Societies	SWNC102	0	0	4	
Total							**21**
#Six-week internship during summer vacation is mandatory, and it is to be evaluated in the V-Sem.							

*Continuous Evaluation Model as per guidelines, and the credit to be awarded at the end of the 6th semester based on Cumulative performance up to the 6th semester.

B. Tech. in Microelectronics and VLSI Engineering

Course Code	:	MVPC 201
Course Title	:	Electronic Devices and Circuits
Number of Credits and L/T/P scheme	:	3/0/0
Prerequisites (Course code)	:	Advanced Engg. Physics (PHIC-103), Circuit Theory (MVPC-101)
Course Category	:	PC

Course Learning Objective:

1. To understand the working principle of the junction diode, its Characteristics and applications.
2. Understand the working principle of the BJT, its Characteristics, equivalent circuit models and applications.
3. Understand JFET, and MOSFET Characteristics in different regimes of operation.
4. Understand the challenges in FET operations and its application as an amplifier.

Course Content:

UNIT I 10 hrs.

Review of JUNCTIONS: Metal-Metal; Metal-Semiconductor; Semiconductor-Semiconductor-Homo-junction and Hetero-junction, Metal-Insulator junction, Metal-Insulator-Semiconductor junction, abrupt and linearly graded P-N junctions, Carrier transport equation, V-I characteristic, C-V characteristic, Zener and Avalanche Breakdown. Diode circuit model.

UNIT II 10 hrs.

P-N junction applications: Rectifiers, Clipping and Clamping Circuits, Voltage Regulator.
BJT: I-V Characteristics, Small signal equivalent circuits, BJT as an amplifier–biasing, small Signal analysis. Frequency response. BJT equivalent circuit models- DC model, h-parameter model, r_e model and hybrid- π model. Single-stage Amplifiers (CB, CE, CC), Frequency Response.

UNIT III 10 hrs.

Theory of field effect transistors: Static characteristics of JFETs and MOSFETs; Analysis of MOS structure, MOS capacitor C-V and concept of accumulation, depletion and inversion; Threshold

Voltage, MOSFET I-V and C-V characteristics. Short channel effects: SS, DIBL, GIDL, surface mobility, CLM.

UNIT IV 10 hrs.

MOSFET transconductance, output conductance, second order effects, body effect, and small signal models, Spice Models.
MOSFET single-stage amplifiers: Basic Concepts, Common Source (CS), Common Gate (CG), Common Drain (CD), Biasing, Small signal analysis, Low frequency and high frequency analysis.
Case study: Electronic waste management, IKS-based solutions.

Text Books / Reference:

1. Tyagi M.S., "Introduction to Semiconductor Materials and Devices", John Wiley & Sons, 1st Edition, Reprint, 2008.
2. Streetman B.G., Banerjee, S.K., "Solid State Electronic Devices", Pearson Education, 7th Edition, 2015.
3. J. Millman and C. Halkias, Integrated Electronics, McGraw-Hill, 2nd Edition, 2009.
4. Behzad Razavi, Design of analog CMOS Integrated circuits, McGraw-Hill, 2nd Edition, 2017.
5. Y. Taur and T. K. Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press,3rd Edition, 2021.
6. A. Sedra and C. Smith, Microelectronic Circuits: Theory and Applications, Oxford University Press, 7th Edition, 2017.

Course outcomes:

At the end of the course, students will be able to
CO1: Understand the working principle of the different junctions, PN junction, V-I and C-V Characteristics.
CO2: Understand the BJT Characteristics and application as an amplifier.
CO3: Understand JFET and MOSFET Characteristics, short channel effects
CO4: Understand the small signal and Spice model of MOSFET.
CO5: Design and analysis of single-stage MOSFET amplifiers.

Course Code	:	MVPC 202
Course Title	:	Digital Design
Number of Credits and L/T/P scheme	:	3/0/0
Prerequisites (Course code)	:	Advance Engg. Physics (PHIC-103)
Course Category	:	PC

Course Learning Objectives:

1. Understand and Apply Number Systems and Data Representation
2. Analyze and Simplify Boolean Expressions for Logic Design
3. Design and Implement Combinational and Arithmetic Circuits
4. Analyze and Design Sequential Logic Circuits
5. Apply Hardware Description Languages (HDLs) and PLDs in Digital Design

UNIT I **10 hrs.**

Number Systems and Codes: Number systems and codes, Conversion of bases, weighted codes - BCD, Excess-3 code, Gray Code and ASCII codes.

Boolean Algebra, Logic Gates, Simplification of Boolean Expressions and Functions:

Laws of Boolean algebra, Theorems of Boolean algebra, Canonical forms of Boolean functions, Minimization of functions using Karnaugh maps, minimization of functions using Quine-McClusky method. Electronic logic gates, Positive and negative logic, families -TTL, ECL and CMOS, Realization of logic gates.

UNIT II **10 hrs.**

Design of Combinational Logic Circuits: Adders -Ripple carry adder and Carry look ahead adder, subtractors, BCD Adder, propagation delay analysis of circuits. Modular combinational logic elements-Decoders, Encoders, Priority encoders, Multiplexers and Demultiplexers, Comparators and magnitude comparators, Parity generators and checkers.

Design of Combinational Circuits using Programmable Logic Devices (PLDs): Programmable Read Only Memories (PROMs), Programmable Logic Arrays (PLAs), Programmable Array Logic (PAL) devices, Design of multiple output circuits using PLDs

UNIT III **10 hrs.**

Sequential Circuits: Latches -RS latch and JK latch, Flip-flops-RS, JK, T and D flip flops, Master-slave flip flops, Edge-triggered flip-flops, Race-around condition. Registers: shift registers, parallel in/serial out (PISO) registers, serial in/parallel out (SIPO) registers, and parallel in/parallel out (PIPO) registers, Counters: ripple counter, synchronous counter, and Johnson counter. Finite State Machines (FSMs): Mealy and Moore models, state diagrams, state tables. Analysis and Design of Synchronous Sequential Circuits, Design of Arithmetic Circuits using Sequential Logic**.**

UNIT IV **10 hrs.**

Introduction to Verilog/VHDL, Basic HDL Constructs for Combinational and Sequential Logic, Simulation and Synthesis Concepts, FPGA, Different types of memories and Organization of memories, Introduction to VLSI Design Flow. Power optimization techniques: Dynamic and Static Power Dissipation, Timing analysis and timing constraints. Case studies: Design towards sustainable technologies.

Text Books:

1. Morris Mano and Michael D. Ciletti, Digital Design, 5th edition, Prentice Hall of India, 2012.
2. Thomas L Floyd, Digital Fundamentals, 11th Edition, Pearson Education, 2017.
3. S Brown, Z Vranesic, Fundamentals of Digital Logic with VHDL Design, 3rd Edition, Tata McGraw Hill, 2017.
4. Wakerly J F, Digital Design: Principles and Practices, 4th Edition, Pearson India, 2008.

Reference Books:

1. C.H. Roth, Larry L. Kinney, Fundamentals of Logic Design, 7th Edition, Cengage, 2013.
2. D.P. Leach, A. P. Malvino, Goutam Saha, Digital Principles and Applications, 8th Edition, Tata Mc-Graw Hill, 2014.
3. J Bhasker, A VHDL primer, 3rd Edition, Pearson Education India, 2015.

Course outcomes:

By the end of this course, students will:
CO1: Understand the fundamental concepts of digital circuits and logic design.
CO2: Gain proficiency in designing combinational and sequential circuits.
CO3: Learn the principles of finite state machines and their applications in VLSI design.
CO4: Develop skills in HDL-based digital design (Verilog).
CO5: Explore the impact of digital design on advanced VLSI architectures.

Course Code	:	MVPC 203
Course Title	:	Signals & Systems
Number of Credits and L/T/P scheme	:	3/0/0
Prerequisites (Course code)	:	MAIC-101 and MAIC-103 (Mathematics)
Course Category	:	PC

Course Learning Objectives

1. To familiarise with different types of signals and systems encountered in Communication engineering
2. To understand the time and frequency domain representation of continuous and discrete-time signals.
3. To provide an understanding of sampling and the sampling theorem.
4. To understand the characteristics of linear time-invariant (LTI) systems
5. To understand Laplace and z-transforms as mathematical tools to analyse continuous and discrete-time signals and systems.

UNIT I: 8 Hrs.

Introduction to Signals: Elementary Signals - Continuous Time (CT) signals, Discrete Time (DT) signals. **Convolution and Correlation of Signals**: Concept of convolution in time domain, Cross correlation and auto correlation of functions, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between convolution and correlation.

Fourier Series: Continuous time signals, Discrete Time signals, periodic signals, Representation of Fourier series, Continuous time periodic signals, Trigonometric Fourier Series, Exponential Fourier Series, Properties of Fourier series, Complex Fourier spectrum.

UNIT II: 11 Hrs.

Fourier Transforms: Deriving Fourier transform from Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, Properties of Fourier transforms. **Sampling**: Sampling theorem, Aliasing effect.

UNIT III: 10 Hrs.

Signal Transmission Through Linear Systems: Introduction to Systems, Classification of Systems, Linear Time Invariant (LTI) systems, Transfer function of a LTI system. Filter characteristics of linear systems, Signal bandwidth, System bandwidth, Ideal LPF, HPF and BPF characteristics.

UNIT IV: 11 Hrs.

Laplace Transforms: Review of Laplace transforms, Inverse Laplace transform, Concept of region of convergence (ROC) for Laplace transforms, Properties of Laplace transform, relation between Laplace transform and Fourier transform of a signal. **Z–Transforms**: Concept of Z-Transform of a discrete sequence. Distinction between Laplace, Fourier and Z transforms, Region of convergence in Z-Transform, Inverse Z- Transform, Properties of Z-transforms.

Text Books:

1. S. Haykin and B. Van Veen, Signals and Systems, John Wiley & Sons Inc, 2 Ed., 2007..
2. M. Mandal and A. Asif, "Continuous and Discrete Time Signals and Systems, Cambridge University Press, 1 Ed., 2007.
3. A.V. Oppenheim, A.S. Willsky and S.H. Nawabi, Signals and Systems, Pearson Education, 2 Ed., 2015.
4. B.P. Lathi, Signals Systems & Communications, B S Publications, 2 Ed., 2020.
5. S. Palani, Signals and Systems, Springer Nature, 2 Ed., 2022.

Reference Books:

1. M. J. Robert and G. Sharma, Fundamentals of Signals and Systems, McGraw Hill Higher Education, 2 Ed., 2017.
2. C. L. Philips, J. M. Parr and Eve A. Riskin, Signals, Systems and Transforms, Pearson Education, 5 Ed., 2014.

NPTEL Web Course: https://nptel.ac.in/courses/108104100

NPTEL Video Course: https://nptel.ac.in/courses/108104100

Course outcomes

At the end of the course student will be able to:

CO1: Understand and represent signals and perform basic operations on signals.
CO2: Determine Fourier representations for continuous-time and discrete-time signals.
CO3: Analyze system properties based on impulse response and Fourier analysis.
CO4: Apply the Laplace transform and Z- transform for analysis of continuous-time and discrete-time signals and systems.
CO5: Understand the process of sampling and the effects of under sampling.

Course Code	:	MVPC-204
Course Title	:	DATA STRUCTURE
Number of Credits and L/T/P scheme	:	3/0/0
Prerequisites (Course code)	:	CSIC-103
Course Category	:	PC

Course Learning Objectives

1. To introduce essential data structures and algorithms, laying the groundwork for effective problem-solving in real-life scenarios.
2. To design, analyse, and implement various data structures, including arrays, linked lists, stacks, queues, trees, and graphs.
3. To cover key algorithmic techniques such as sorting, searching, recursion, and dynamic programming, providing a comprehensive understanding of algorithm design.
4. To understand the efficiency and trade-offs associated with different data structures and algorithms, enabling students to make informed decisions in their implementations.

Course Content:

UNIT I 10 hrs.

Introduction to Data Structures and Algorithms, Overview of data structures and algorithms, Importance and applications of data structures, Arrays and Linked Lists, Design and implementation of arrays, Implementation and manipulation of linked lists.

UNIT II 10 hrs.

Stacks and Queues, Applications and implementation of stacks, Queue operations and circular queues, Trees and Binary Trees, Introduction to tree structures Binary tree operations and traversal, Balanced Trees Graphs, AVL trees and other balanced trees.

UNIT III 08 hrs.

Basics of graph theory and graph representations, Sorting and Searching Algorithms, Comparison and analysis of sorting algorithms, Searching techniques and their applications

UNIT IV 12 hrs.

Recursion and Dynamic Programming, Recursive problem-solving strategies, Principles and applications of dynamic programming, Review, Project Work, and Practical Applications. Recap of key concepts and algorithms, Application of data structures and algorithms in practical scenarios.

Reference Books:

1. **G. A. Vijayalakshmi Pai**, *A Textbook of Data Structures and Algorithms: Mastering Linear Data Structures*, **John Wiley & Sons / Wiley-ISTE**, 1st ed., **2023**
2. **Steven S. Skiena**, *The Algorithm Design Manual*, **Springer**, 3rd ed., **2020**
3. **Narasimha Karumanchi**, *Data Structures and Algorithms Made Easy*, **Career Monk Publications**, Revised ed., **2016**
4. **Sachi Nandan Mohanty & Pabitra Kumar Tripathy**, *Data Structures and Algorithms Using C++: A Practical Implementation*, **Scrivener Publishing LLC**, 1st ed., **2021**
5. **Sartaj Sahni**, *Data Structures, Algorithms and Applications in C++*, **WCB/McGraw-Hill**, 1st ed., **1998**
6. **Aaron M. Tenenbaum, Moshe J. Augenstein & Yedidyah Langsam**, *Data Structures Using C and C++*, **Prentice Hall of India**, 2nd ed., **2006**

Course outcomes:

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

CO1: Understand the fundamental concepts and importance of data structures.

CO2: Design and implement arrays, linked lists, stacks, and queues.

CO3: Apply sorting and searching algorithms efficiently.

CO4: Analyse and implement various structures, including binary trees and balanced trees.

CO5: Apply data structures and algorithms to solve real-world programming challenges.

CO6: Write efficient and well-organised code for complex problem-solving.

Course Code	:	MVPC 205
Course Title	:	Computer and Processor Architecture
Number of Credits and L/T/P scheme	:	3/0/0
Prerequisites (Course code)	:	Digital Design (MVPC 202)
Course Category	:	PC

Course Learning Objectives

1. Introduce the basic concepts of ISA of a computer.
2. Analyse the internal organisation of processors, including register transfer, control units (hardwired and microprogrammed), and pipelining.
3. Explore the principles of I/O interfacing, interrupt mechanisms, and DMA.
4. Understand the architecture, programming, and interfacing of the 8086 microprocessor.
5. Apply knowledge of microprocessors to design basic microprocessor-based systems, considering sustainable technologies.

UNIT I **10 hrs**

Introduction to instruction set architecture, Basic organization of computing machine: fetch, decode, and execute; Instruction set types, instruction format, addressing modes.
Processor Architecture: Register transfer and micro-operations, CISC and RISC processors. Hardwired control, Microprogrammed control, Pipelining: Basic concepts, instruction pipeline, hazards, techniques for handling hazards.

UNIT II **10 hrs**

Memory Architecture: Storage systems, introduction to memory hierarchy: importance of temporal and spatial locality; main memory organization, cache memory: address mapping, block size, replacement, and store policies; virtual memory system: page table and TLB.
Interfacing and I/O Organization: External storage; IO fundamentals: handshaking, buffering, programmed IO, interrupt driven IO; Interrupt handling mechanism, Buses: protocols, arbitration, direct memory access (DMA).

UNIT III **10 hrs**

Microprocessors: 8086-architecture, operation, pin configuration and functions, bus organization, timing diagrams. Addressing mode, instruction set, Overview/concept of basic peripherals and their interfacing with 8086.

UNIT IV **10 hrs**

Special purpose programmable devices and their interfacing like 8253, 8259, 8257. Basic features of 32-bit processors. Recent advances in Microprocessor architectures.
Architectures towards sustainable technologies. Case studies: Design of Microprocessor based systems.

Text Books:

1. Mano, Morris M., Computer System Architecture, Pearson India, 3rd Edition, 2017.
2. C.Hamacher Z. Vranesic and S. Zaky, Computer Organization, McGraw-Hill, 5th Edition, 2011.
3. K Bhurchandi, A. K. Ray, Advanced Microprocessor and Peripherals, McGraw Hill Education India, 3rd Edition, 2017.
4. D.V. Hall, Microprocessors & Interfacing, McGraw Hill higher Education, 2005.

Reference Books:

1. Hayes, J.P., Computer Architecture and Organization, McGraw Hill, 3rd Edition, 2017.
2. Stallings, W., Computer Organization & Architecture, Pearson Education, 11th Edition, 2022.
3. M. Rafiquzzman, Microprocessors: Theory & Applications (Intel & Motorola), PHI, 1992.

Course outcomes

At the end of the course student will be able to

CO1: Understand the fundamentals of instruction set architecture and the organization of computing systems, including instruction types, formats, and addressing modes.

CO2: Analyze and compare different processor architectures such as CISC and RISC, and explain control unit design and instruction pipelining techniques along with associated hazards.

CO3: Describe I/O organization and interfacing techniques, including programmed I/O, interrupt-driven I/O, DMA, and bus protocols.

CO4: Demonstrate an in-depth understanding of the 8086 microprocessor architecture, instruction set, timing diagrams, and peripheral interfacing.

CO5: Explore special-purpose programmable devices and recent trends in microprocessor architecture, and apply this knowledge in designing microprocessor-based systems with a focus on sustainable technologies.

MVPC 206 ELECTRONICS-I LAB

Pre-requisite: PHIC-101, MVPC-201

L	T	P	Credits	Total contact hours
-	-	2	1	20

Course Learning objectives:

1. To apply knowledge of electronics devices to hands-on laboratory experience.
2. To design and analyze various electronic circuits using p-n junction diode, Zener diode
3. To design and analyze various electronic circuits using BJT, JFET and MOSFET, perform hand-worked analytical analysis of these circuits.
4. Write formal laboratory reports summarizing the results obtained and discussing the correlation between the analytical predictions and the observed behaviours.

List of Experiments:

1. PN Junction diode characteristics.
A. Forward bias, B. Reverse bias.
2. Zener diode characteristics and voltage regulator.
3. Half wave Rectifier with and without filter.
4. Full wave Rectifier with and without filter.
5. Clipping and Clamping Circuits
6. Transistor CB characteristics (Input and Output).
7. Transistor CE characteristics (Input and Output).
8. Frequency response of CE Amplifier.
9. Frequency response of CC Amplifier (Emitter Follower).
10. FET Characteristics

Course Outcomes: At the end of the course the student will be able to:
CO 1: To familiarize students with measuring instruments.
CO 2: To demonstrate students the working and input-output characteristics of p-n junction diode, Zener diode, BJT, JFET and MOSFET.
CO 3: To demonstrate students Halfwave & Full wave Rectifier with and without filter.
CO 4: To demonstrate students' Clipping and Clamping Circuits.
CO 5: To demonstrate to students the working of single-stage amplifier using BJT.

MVPC 207 DIGITAL DESIGN LAB

Pre-requisite: MVPC-202

L	T	P	Credits	Total contact hours
-	-	2	1	20

Course Learning objectives:

1. Design and implement combinational logic circuits using basic gates, Boolean expressions, and components such as adders, multiplexers, and encoders.

2. Construct and analyze sequential circuits, including flip-flops, counters, shift registers, and finite state machines.

3. Simulate and synthesize digital systems using Hardware Description Languages (HDL) such as Verilog or VHDL.

4. Apply digital design concepts to real-world hardware through hands-on experiments and optional FPGA-based implementations.

List of Experiments:

1. **Verification of Basic Logic Gates**: Study and verify the truth tables of AND, OR, NOT, NAND, NOR, XOR, and XNOR gates.
2. **Boolean Function Implementation**: Implement simplified Boolean expressions using basic and universal gates.
3. **Code Converters**: Design and implement binary to Gray code and Excess-3 to BCD code converters, and vice versa.
4. **Adders and Subtractors**: Construct half and full adders and subtractors using logic gates.
5. **Magnitude Comparators**: Design 2-bit and 8-bit magnitude comparators.
6. **Multiplexers and Demultiplexers**: Implement 2:1, 4:1, and 8:1 multiplexers, and their corresponding demultiplexers.
7. **Encoders and Decoders**: Design 3-to-8 line decoders and 8-to-3 line encoders.
8. **7-Segment Display Decoder**: Implement a BCD to 7-segment display decoder.
9. **Flip-Flops**: Study and implement SR, JK, D, and T flip-flops using logic gates.
10. **Shift Registers**: Design and implement SISO, SIPO, PISO, and PIPO shift registers.

11. **Counters**: Construct and test up/down counters, mod-N counters, and decade counters using flip-flops.
12. **Sequence Generators**: Design sequence generators and detectors using flip-flops.

Advanced Topics (Optional)

13. **Finite State Machines (FSMs)**: Design and implement Moore and Mealy state machines.
14. **Arithmetic Circuits**: Implement carry-lookahead adders, carry-select adders, and array multipliers.
15. **Digital Signal Processing (DSP) Components**: Design and simulate FIR filters and ALUs.
16. **Combinational Circuits in HDL**: Simulate adders, subtractors, encoders, and decoders using Verilog or VHDL.
17. **Sequential Circuits in HDL**: Simulate counters and shift registers using Verilog or VHDL.
18. **Synthesis and Implementation**: Synthesize and implement digital circuits on FPGA platforms.

Course Outcomes:

At the end of the course the student will be able to:

CO1: Understand and verify the functionality of basic logic gates and combinational circuits through hands-on experiments.

CO2: Design and implement combinational logic components such as adders, subtractors, encoders, decoders, multiplexers, and display systems.

CO3: Analyze and construct sequential circuits including flip-flops, counters, and shift registers for various timing and control applications.

CO4: Simulate and verify digital circuits using Hardware Description Languages (Verilog/VHDL) in a digital design environment.

CO5: Integrate theoretical digital design concepts with practical implementation on breadboards or FPGA kits.

CO6: Develop problem-solving and teamwork skills through design-based experiments and mini-projects in digital logic.

MVPC 208 PROGRAMMING WITH MATLAB

Pre-requisite: NA

L	T	P	Credits	Total contact hours
-	-	2	1	20

Course Learning Objectives:

1. To provide a foundation in programming for engineering problem solving using the MATLAB software package.
2. Students will develop the skills analyze and break down an engineering program and solve it algorithmically using MATLAB.
3. Students will have an understanding of various programming constructs and how they can be used to solve a computational problem.

List of Experiments:

1. To study Basic MATLAB arithmetic Commands.
2. For an electrical circuit with an inductance L=0.01 mH and resistance R=100Ω, the damped natural frequency of oscillation f=$\sqrt{\frac{1}{LC}-\frac{R^2}{4C^2}}$ write a program to calculate the frequency for different values of c varying from 0.1 to 1 in step of 0.01.

3. Write a MATLAB program to define the vectors:

$$\underline{u} =< 1,2,3,4 > \; and \; \underline{v} =< 2,3,4,5 >$$

Now determine the following using MATLAB

$a)\ Multiply\ the\ vector\ v\ with\ a\ scalar\ quantity\ i.e.\ 5\underline{v}$

$b)\ Take\ the\ power\ of\ 5\ of\ a\ vector\ i.e.\ \underline{u}^5$

$c)\ Take\ the\ power\ of\ 5\ of\ a\ vector\ i.e.\ \underline{v}^5$

$d)\ Multiply\ the\ vectors\ element\ by\ element\ i.e.\ \underline{\underline{u}.* \underline{v}}$

$e)\ First\ take\ the\ transpose\ of\ a\ vector\ and\ then\ multiply\ the\ vectorselement\ by\ element\ \underline{u}. * \underline{v}^t$

4. Write a MATLAB program to calculate:
   (i) Summation of a number k from 0 to 100 i.e. $\sum_{k=0}^{100} k$

(ii) Summation of a number k^2 from 0 to 100 i.e. $\sum_{k=0}^{100} k^2$

(iii) Summation of a number 1/k from 0 to 100 i.e. $\sum_{k=1}^{100} \frac{1}{k}$

(iv) Summation of a number $1/k^2$ from 0 to 100 i.e. $\sum_{k=1}^{100} \frac{1}{k^2}$

5. Write a MATLAB program to break a function, f(x) into odd and even parts, one can compute the two function

$$f_{odd}(x) = \frac{f(x) - f(-x)}{2}$$

$$f_{even}(x) = \frac{f(x) + f(-x)}{2}$$

6. Calculate using MATLAB
   (i) Define the symbolic variable x.
   (ii) Define the symbolic function $y = e^x$
   (iii) Define the symbolic function $y = e^{-x}$
   (iv) Using the result of previous two sections, calculate $f_{odd}(x)$ and $f_{even}(x)$ for the function $y = e^x$
7. Write a MATLAB program to generate different waveforms –
   (i) Square wave
   (ii) Sine wave
   (iii) Triangle wave
   (iv) Exponential wave
   (v) unit step function
   (vi) unit impulse function
   (vii) A rectangular pulse of width 2
   (viii) Unit ramp function

8. Draw graphs of the functions using MATLAB

$$(i)\frac{sin\,sin\,x}{x}\,(ii)\frac{1}{(x-1)^2}+x\quad(iii)\frac{x^2+1}{x^2-4}\,(iv)\frac{(10-x)^{\frac{1}{3}}-2}{(4-x^2)^{\frac{1}{2}}}$$

9. Draw the circle of radius r=5 using MATLAB.
10. Write a function in MATLAB for factorial to compute the factorial n! . for n= 50.
11. Write a MATLAB program to compute sum of all powers of 2 below 50 using while command.
12. Write a MATLAB program to solve the equations:
    $-6x - 2y + 2z = 15$
    $-3x + 4y - 3z = 13$
    $2x + 4y - 7z = -9$
13. The Fibonacci sequence starts off with the numbers 0 and 1, then succeeding terms are the sum of its two immediate predecessors. Write a MATLAB program for Fibonacci series.
14. Write a MATLAB program for the calculation of the following:
    1-1/2+ 1/3- 1/4 + 1/5 ………

15. Write a MATLAB program to generalize for the following:

$$s(20) = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \cdots + \frac{1}{20^2}$$

$$s(21) = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \cdots + \frac{1}{21^2}$$

.

.

$$s(100) = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \cdots + \frac{1}{100^2}$$

16. The area, A, of a triangle with sides of length a, b and c is given by $A = \sqrt{(s-a)(s-b)(s-c)}$ where s=(a+b+c)/2. Write a Matlab function that will accept the values a, b and c as inputs and return the value of A as output.

17. Write a MATLAB program for a positive number to compute and display the even powers of 2 less than or equal to positive number.

18. Use the command plot3(x,y,z) to plot the circular helix $x(t) = sin\, sin\, t\,, y(t) = cos\, cos\, t\ , z(t) = t, 0 \le t \le 20$

19. Plot the surface defined by the function using MATLAB:

$f(x, y) = (x-3)^2 + (y-2)^2$ for $2 \le x \le 4, 1 \le y \le 3$

20. Find the solution of first order ODE:

$$\dot{x} = 2x + 5\, sin\, sin\, t\,, x(0) = 1$$

21. Plot $r^2 = 2\, sin\, sin\, 5t,\ for\ 0 \le x \le 2\pi$ using polar command in Matlab.

24. Compute the first order differential equation

$$\frac{dy}{dx} = x + t$$

With initial condition x(0)=0

25. Compute the following transcendental equation using MATLAB:

$sin\, sin\, x\ = e^x - 5$ here initial value x0=1.

26. Determine the convolution of x (t) $= \frac{1}{1+t^2}$ with itself.

27. Compute the cross correlation between the following two sequences.

X(n)= {1,2, -1,3}, h(n)= {3, -2,1,4}

28. Let x (n)=u(n)-u(n-10). Decompose x(n) into even and odd components.

29. Let x (t)=$e^{-1000}|t|$

a) Sample x(t) at fs=5000 samples/sec to obtain x(n)

b) From the samples x(n), reconstruct x(t).

30. Using MATLAB symbolic math toolbox, determine the Laplace Transform of the following

a) x(t)=t$e^{-at}u(t)$

22. Plot $z = -\frac{5}{1+x^2+y^2}, for\ |x| \le 3, |y| \le 3$ using contour3 command in Matlab.

23. Compute the following integral:

$$I = \int_{-1}^{1} \int_{0}^{2} (1 - 6x^2 y) dx dy$$

b) x(t) = $[sin\ sin\ (at) + cos\ cos\ (bt)(u(t))\ ]$

Course Outcomes:

At the end of the course the student will be able to:

CO 1: Learn various aspects of MATLAB such as interface, syntax, debugging and execution.

CO 2: Understand how various MATLAB scripts are created, saved and executed.

CO 3: Apply above knowledge in writing simple programs.

CO 4: Learn basic concepts of simulation using SIMULINK and write complex programs.

Course Code	:	MVPC 209
Course Title	:	Analog Electronics
Number of Credits and L/T/P scheme	:	3/0/0
Prerequisites (Course code)	:	MVPC 201 (Electronic Devices and Circuits)
Course Category	:	PC

Course Learning Objectives

1. To introduce the fundamental concepts relevant to the BJT and MOSFET.
2. To understand the basics of single and multi-stage amplifiers at low and high frequencies.
3. To introduce the concept of power efficiency of an amplifier and its class.
4. To introduce the concept of feedback topologies and oscillators.
5. To introduce the concept of op-amps and ADC/DAC converters.

UNIT I 10 hrs.

Revisiting BJT - operation and characteristic equations. Revisiting MOSFET - operation and characteristic equations. Revisiting - Analysis of simple non-linear circuits (containing one transistor) and introducing the notion of signal amplification. Small signal models of transistors. Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier.

UNIT II 12 hrs.

Introduction to Single Stage Amplifier, Multistage Amplifier, General Cascaded System, RC coupled amplifier and its frequency response, Cascade amplifier, Cascode amplifier, Darlington Compound Configuration, Multistage Frequency Effect. Power efficiency of an amplifier, Different modes of operation of amplifiers and their power efficiency and linearity issues: Class A, Class B, Class AB and Class C.

UNIT III 10 hrs.

Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth, etc., calculation with practical circuits, concept of stability, gain margin and phase margin.
Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt etc.), non-sinusoidal oscillators.

UNIT IV 08 hrs.

Introduction to Op-Amp, ideal Op-Amp, equivalent circuit, Transfer characteristics, Op-Amp with negative feedback, inverting and non-inverting amplifiers, Digital-to-analog converters (DAC), Analog-to-digital converters (ADC).

Text / Reference Books:

1. Electronic Devices & Circuit Theory by R. Boylestad and L. Nashelsky, Pearson, 11 Ed, 2013.
2. Microelectronic Circuits by A. Sedra and K. Smith, Oxford University Press (8th ed.) (2020).
3. Integrated Electronics: Analog and Digital Circuits and Systems by J. Millman and C. Halkias, McGraw-Hill, India (2nd ed., revised) (2019).
4. J. Millman and C. Halkias, Integrated Electronics, McGraw-Hill, 2nd Edition, 2009.

Course outcomes:

Upon successful completion of the course, the students will be able to

CO1: Understand the basics of single and multi-stage amplifiers at low and high frequencies.

CO2: Understand the concept of power efficiency of an amplifier and its class.

CO3: Describe the design trade-offs in analog amplifier circuits.

CO4: Describe the concept of feedback topologies and different types of oscillators.

CO5: Design different types of op-amp configuration ADC/DAC converters.

Course Code	:	MVPC 210
Course Title	:	Introduction to Communication Engineering
Number of Credits and L/T/P scheme	:	3/0/0
Prerequisites (Course code)	:	MVPC 203 (Signals and Systems)
Course Category	:	PC

Course Learning Objectives

1. Understanding the basic principles of communication systems, including noise, modulation, and demodulation
2. To learn various analog modulation techniques like Amplitude Modulation (AM) and Frequency Modulation (FM), as well as pulse modulation techniques.
3. To acquire knowledge about digital modulation, baseband transmission, and digital communication systems, including Pulse Code Modulation (PCM).
4. To study the effect of noise on AM and FM receivers.

UNIT I: 10 Hrs.

Amplitude modulation: Block diagram of a communication system. need for modulation, Amplitude modulation, Double-Sideband Suppressed Carrier, Double-Sideband Full Carrier, Single Sideband and vestigial sideband modulation; Demodulation: Carrier Recovery in AM, Coherent Demodulation, Envelope Detector, Square-Law Demodulator; TRF and Super Heterodyne Receiver.

UNIT II: 10 Hrs.

Angle Modulation

Frequency Modulation, Phase Modulation, Narrow Band Angle Modulation, Wideband FM, Modulators, Demodulators. Sampling, Pulse amplitude modulation, Pulse width modulation, Pulse position modulation. FM receiver, comparison of AM and FM receivers.

UNIT III: 10 Hrs.

Digital Modulation Techniques: Sampling Theorem, Pulse Code Modulation (PCM), Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), and Frequency Shift Keying (FSK), modulation and demodulation schemes and their performance analysis, Comparison of modulation schemes.

UNIT IV 10 Hrs.

Performance Analysis of Receivers under AWGN

Effects of Noise in Analog Modulation Systems. Case study of AM and FM Receivers. Analog and Digital Receiver performance in AWGN.

Text Books:

1. S. Haykins, Communication Systems, Wiley & Sons Inc., 5 Ed., 2022.
2. H. Taub and D. L. Schilling and G. Saha, Principles of Communication Systems, McGraw-Hill, 4 Ed., 2020.
3. B.P. Lathi and Z. Ding, Modern Digital and Analog Communications, Oxford Higher Education, 4 Ed., 2017.
4. S. Haykins, Digital Communication Systems, Wiley, 4th Ed. 2021.

Reference Books:

1. G. Kennedy, B. Davis and S R M Prasanna, Electronics & Communication Systems, Tata McGraw Hill, 5 Ed., 2019.
2. J. G. Proakis and M. Salehi, Digital Communications, McGraw-Hill, 5 Ed., 2014.
3. R. G. Gallager, Principles of Digital Communication, Cambridge University Press, 3 Ed., 2008.
4. A. Lapidoth, A Foundation in Digital Communication, Cambridge University Press, 2 Ed., 2017.

Course outcomes

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

CO1: Understand the principles of communication systems.
CO2. Understand various analog modulation and demodulation techniques.
CO3: understand various digital modulation and demodulation techniques.
CO4: Observe the effect of noise on AM and FM receivers.

Course Code	:	MVPC 211
Course Title	:	Microcontroller & Embedded System Design
Number of Credits and L/T/P scheme	:	3
Prerequisites (Course code)	:	MVPC 202 (Digital Design), MVPC 205 (Computer and Processor Architecture)
Course Category	:	PC

Course Learning Objectives

1. Introduce the basics of microcontroller architecture and programming.
2. Explain the components and design principles of embedded systems.
3. Familiarise students with interfacing peripherals and writing embedded programs.
4. Lay the foundation for real-world embedded applications.

Course Content

The syllabus introduces the fundamentals of microcontrollers and embedded systems, starting with a comparison between embedded and general-purpose systems, and provides a basic understanding of real-time operating systems and embedded systems in IoT and smart devices.

Unit I – Introduction to Microcontrollers (10 hrs)

Basics of embedded systems vs general-purpose systems, Introduction to 8051 microcontroller: architecture, memory organization, Registers, I/O ports, and basic instruction set, Addressing modes and simple assembly language programming

Unit II – Programming and Interfacing (10 hrs)

Timer and counter programming in 8051, Serial communication: basics and interfacing, Interrupts: types and handling in 8051, Interfacing LEDs, switches, LCDs, and 7-segment displays.

Unit III – Embedded Systems Basics (10 hrs)

Embedded system components: sensors, actuators, controllers, Overview of embedded C programming, Memory types in embedded systems, Design constraints: power, size, real-time requirements.

Unit IV – Embedded Applications and Trends (10 hrs)

Case studies: temperature control, motor control, home automation. Introduction to modern microcontrollers (overview of Arduino, PIC, ARM).

Concept of real-time operating systems (RTOS), Embedded systems in IoT and smart devices (introductory view).

Study of microcontroller-based embedded system design with a focus on energy efficiency, smart automation, and applications in sustainable technologies.

Text Books:

1. Muhammad Ali Mazidi & Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson, 2^{nd} Edition, 2011.
2. Raj Kamal, Embedded Systems: Architecture, Programming and Design, McGraw-Hill, 2^{nd} Edition, 2008.

Reference Books:

1. Kenneth J. Ayala, The 8051 Microcontroller: Architecture, Programming & Applications, Cengage Learning India, 3^{rd} Edition, 2008.
2. Shibu K.V., Introduction to Embedded Systems, McGraw-Hill, 1^{st} Edition, 2009.

Course outcomes

At the end of the course student will be able to

CO1: Understand the architecture and features of the 8051 microcontroller.

CO2: Write and debug simple assembly and C programs for microcontrollers.

CO3: Interface various input/output peripherals with microcontrollers.

CO4: Describe the structure and functioning of a basic embedded system.

CO5: Demonstrate understanding of real-time constraints in embedded applications.

Course Code	:	MVPC 212
Course Title	:	Control Systems
Number of Credits and L/T/P scheme	:	3/0/0
Prerequisites (Course code)	:	MVPC 203 (Signals & Systems)
Course Category	:	PC

Course Learning Objectives

1. To understand the basics of control systems and design mathematical models using block diagram reduction and signal flow graph techniques.
2. To be able to do time-domain and frequency-domain analyses of the model to predict the system's behaviour.
3. To analyse the stability of a system from the transfer function.
4. To familiarise oneself with the state space model of the system.

UNIT I: 9 Hrs.

Introduction to control systems, types of control systems, basic control system components, concept of feedback and its impact on the performance, differential equations of physical systems, Laplace transforms, transfer function, effect of poles and zeros on stability, block diagram reduction techniques, signal flow graph, Mason's gain formula

UNIT II: 10 Hrs.

Standard test signals, time response analysis of first and second order systems, steady state analysis, steady state error, static error constants, stability, Routh-Hurwitz theorem, relative stability criteria, Root locus technique for stability, Root contours

UNIT III: 12 Hrs.

Frequency response analysis of first and second order systems, Polar plot, gain margin, phase margin, Nyquist stability criteria, Bode Plot, compensation and their realization in time and frequency domain, design of compensators: lead, lag, lead-lag, Op-amp based digital implementation of compensators, tuning of process controllers

UNIT IV: 9 Hrs.

Controllers: Proportional, Derivative, Integral, PI, PD and PID, state space analysis, Controllability and Observability
Applications: Home Automation, Transportation Systems, Automobiles and Consumer Electronics. Case study: control design

Text Books:

1. I. J. Nagrath and M. Gopal, Control Systems Engineering, New Age International Pvt. Ltd., 8 Ed., 2024.
2. M Gopal, Control Systems Principles and Design, McGraw Hill Education, 4 Ed., 2012.
3. S. Ghosh, Control Systems, Pearson Education, 2 Ed., 2017.
4. A.K. Jairath, Solutions and Problems of Control Systems, CBS Publishers, 7 Ed., 2021.

Reference Books:

1. G. F. Franklin, J. D. Powell and A. Emami-Naeini, Feedback Control of Dynamic Systems, Pearson Education, 8 Ed., 2022.
2. K. Ogata, Modern Control Engineering, Pearson Education India., 5 Ed., 2015.
3. B. C. Kuo and F. Golnaraghi, Automatic Control Systems, Wiley, 9 Ed., 2014.
4. N. S. Nise, Control System Engineering, Wiley, 8 Ed., 2024.

NPTEL video: https://archive.nptel.ac.in/courses/107/106/107106081/
https://nptel.ac.in/courses/108106098

Course outcomes

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

CO1: Evaluate the transfer function and stability of a linear time-invariant system
CO2: Apply block diagram manipulation and signal flow graph methods to obtain transfer function of systems
CO3: Investigate the performance of a given system in time and frequency domains.
CO4: Determine the stability analysis of a system using Root locus, Bode plots and Nyquist plots.
CO5: Determine the controller or compensator configuration and parameter of a given system

Course Code	:	MVPC 213
Course Title	:	Electromagnetic Field Theory
Number of Credits and L/T/P scheme	:	3/0/0
Prerequisites (Course code)	:	PHIC101 (Engineering Physics), PHIC103 (Advanced Engg. Physics)
Course Category	:	PC

Course Learning Objectives

1. To understand the basic concepts of vector analysis, co-ordinate transformation and space derivative.
2. To introduce the fundamental concepts relevant to the electrostatic field and the application of Gauss' law.
3. To introduce the fundamental concepts relevant to the magnetostatic field and application of Biot-Savart's law.
4. To introduce the concept of Maxwell's equations and how electromagnetic waves propagates.
5. To give an understanding of wave propagation in guided media.

UNIT-01 INTRODUCTION 10 Hrs.

Fundamental of vector algebra, Scalar & vector fields, Introduction and transformation on different coordinate systems: rectangular, cylindrical and spherical coordinate system, introduction to line, Surface and volume integrals, Definition of gradient, Divergent and curl of a vector and their physical significance.

UNIT-02 ELECTROSTATICS 10 Hrs.

Principle of Coulomb's law, Definition of electric field intensity from point charges, Field due to continuous distribution of charges on an infinite and finite line, Electric Field due to an infinite uniformly charged sheet, Gauss's law and its applications, Electric flux density, Potential fields duo to electric dipole, Laplace's and Poison's equations

UNIT-03 MAGNETOSTATICS 10

Hrs.

Definition and explanation on Magnetic Field intensity due to a finite and infinite wire carrying current, Magnetic field intensity on rectangular loop carrying current, Ampere's Circuital law and its applications, Biot-Savart's law, Lorentz force equation for a moving charge, Magnetic Vector Potential.

UNIT-04 TIME VARYING EM FIELD 10 Hrs.

Maxwell's equation in differential and integral vector form and their interpretations, Continuity of currents, Conduction and displacement current, Boundary conditions, Helmholtz equations, uniform plane wave in dielectric and conductor media, Skin effect and depth of penetration, reflection and refraction of plane waves at boundaries for normal incidence and surface impedance, Energy Flow and Poynting theorem, Introduction to Micro strip transmission lines.

Text Books:

1. Elements of Engineering Electromagnetics by Matthew N.O. Sadiku, Oxford University Press, **Edition**: 7th (2020).
2. Electromagnetic Waves and Radiating Systems by Jordan and Balmain, PHI, Second Ed. (2015)
3. Engineering Electromagnetics by William Hayt, TATA McGraw-Hill, **Edition**: 9th (2019)
4. Electromagnetic by J.D. Kraus, McGraw-Hill, **Edition**: 4th (1991)

Course outcomes:

Upon successful completion of the course, the students will be able to
C01: Describe the fields using vector algebra and field transformation from one coordinate system to another
CO2: Describe the force between charges and equipotential surfaces, and electrostatic shielding/ screening.
CO3: Describe the magnetic field due to a current element and the force on a charge particle due to the magnetic field.
C04: Describe the electromagnetic wave phenomenon and the power carried by an electromagnetic wave.
C05: Understand how the transmission line theory bridges the gap between circuit theory and field theory.

MVPC 214 ELECTRONICS –II LAB

Pre-requisite: MVPC-201and MVPC-209

L	T	P	Credits	Total contact hours
-	-	2	1	20

Course Learning Objectives:

1. To familiarize the students with the practical implementation of single and multistage amplifiers
2. To familiarize the students with various Feedback amplifiers and Oscillator Circuits.
3. To familiarize the students with various Op-Amp-based circuits.
4. To introduce LT Spice software to the students for designing single-stage MOSFET amplifiers.

List of Experiments:

1. Design a single-stage RC Coupled Amplifier and plot it's gain frequency response.
2. Design a double-stage RC Coupled Amplifier and Plot it's gain frequency response.
3. Feedback Amplifier
4. Design an RC phase shift oscillator.
5. Design a Wein Bridge oscillator.
6. Design a Voltage to Current Converter and Current to Voltage Converter using IC- 741.
7. To design and test the performance of the integrator and differentiator circuits using an op-amp (IC-741).
8. Introduction to LT-Spice design software and Study of MOSFET Characteristics using LT-Spice.
9. Design and Analysis of Single-Stage Common-Source Amplifier in LT-Spice.
10. Design and Analysis of a Single-Stage Common-Gate amplifier in LT-Spice.
11. Design and Analysis of Single-Stage Common-Drain Amplifier in LT-Spice.

Course Outcomes:
At the end of the course the student will be able to:
CO1: To Design & analyse a single-stage, double-stage RC Coupled Amplifier and plot it's gain frequency response.
CO2: To Design & analyse Feedback amplifiers and oscillators.
CO3: To design and test the performance of Voltage to Current and Current to Voltage Converter, integrator and differentiator circuit using op – amp (IC-741).
CO4: To design single-stage amplifiers using LT-Spice.

MVPC-215 COMMUNICATION LAB

Pre-requisite: MVPC-210

L	T	P	Credits	Total contact hours
-	-	2	1	20

Course Learning Objectives

1. To understand the basics of the sampling theorem and the use of a Superheterodyne receiver.
2. To familiarise the students with the practical implementation of analog modulation and demodulation techniques
3. To familiarise the students with the practical implementation of digital modulation and demodulation techniques
4. To learn and design an FM receiver.

List of Experiments:

1. To generate an Amplitude Modulated waveform with given modulation index and perform Demodulation.
2. To generate a Frequency Modulated waveform and study its modulation index and perform Demodulation.
3. To study Delta Modulation and Demodulation.
4. To study PAM, PWM and PPM Modulation and Demodulation.
5. To study the Diode Detector and selectivity of the Superheterodyne receiver.
6. Verification of the sampling theorem.
7. To study PSK modulation and demodulation.
8. To study FSK modulation and demodulation.
9. To study ASK modulation and demodulation.
10. To study PCM modulation and demodulation.
11. Minor Project: Design and demonstrate an AM/FM receiver.

Course Outcomes:

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

CO1: Understand the basic hardware components used for modulation and demodulation schemes of analog and digital communication.
CO2: Design and Implementation of the different types of modulation schemes.
CO3: Understand the waveforms associated with the different types of modulation schemes.
CO4: Learn about the sampling theorem and the use of a Superheterodyne receiver.

MVPC 216 MICROCONTROLLER & EMBEDDED SYSTEM DESIGN LAB

Pre-requisite: MVPC-211 and MVPC-205

L	T	P	Credits	Total contact hours
-	-	2	1	20

Course Learning Objectives:

1. Gain foundational knowledge of ARM processor architecture, including registers, instruction sets, and low-level assembly programming.
2. Develop practical skills in interfacing and controlling peripherals (LEDs, switches, displays, sensors) using GPIOs and ADCs.
3. Write embedded C code and use RTOS for implementing multitasking in real-time embedded applications.
4. Plan and execute a mini-project that integrates various peripherals and concepts, enhancing problem-solving and system design abilities.

List of Experiments:

1. ARM Processor Fundamentals
Objective: Understand ARM architecture, registers, CPSR, and pipeline stages.
Tools: ARM Cortex-M development boards (e.g., STM32, LPC2148), Keil uVision.

2. ARM Assembly Language Programming
Objective: Write and execute ARM assembly programs using data processing and branching instructions.

3. Interfacing Peripherals
Objective: Interface LEDs, switches, 7-segment displays, and LCDs with ARM microcontrollers.
Tasks: Control LEDs, read switch inputs, and display data on 7-segment displays and LCDs.

4. Timer and Interrupt Programming
Objective: Configure and use timers for generating time delays and periodic interrupts.
Tasks: Implement LED blinking using timer-based interrupts.

5. UART Communication
Objective: Set up UART for serial communication between ARM board and PC.
Tasks: Send and receive data over UART using terminal software.

6. ADC and Sensor Interfacing
Objective: Interface analog sensors (e.g., temperature sensor) using ADC module.
Tasks: Read analog values and display them on an LCD.

7. PWM Generation
Objective: Generate PWM signals using ARM timers.
Tasks: Control the brightness of an LED or speed of a motor using PWM.

8. Real-Time Operating Systems (RTOS) Basics
Objective: Understand the basics of RTOS and multitasking.
Tasks: Create simple tasks and manage them using an RTOS.

9. Embedded C Programming
Objective: Develop embedded applications using C programming language.
Tasks: Write programs to interface memory, I/Os with processor.

10. Mini Project
Objective: Implement a mini project integrating various peripherals and concepts learned.
Examples: Temperature monitoring system, home automation using ARM microcontroller.

Course Outcomes:
At the end of the course the student will be able to:

CO1: Demonstrate an understanding of ARM processor architecture, registers, instruction formats, and programming using Assembly and Embedded C.
CO2: Develop and execute basic ARM assembly programs for data processing, control flow, and memory operations.
CO3: Interface input/output peripherals (LEDs, switches, LCDs, sensors, etc.) with ARM-based microcontrollers and implement their control logic.
CO4: Implement timer-based applications and handle external/internal interrupts in embedded systems.
CO5: Configure and use communication protocols (e.g., UART) and analog peripherals (e.g., ADC, PWM) in real-time applications.
CO6: Apply real-time operating system (RTOS) concepts such as task creation, synchronization, and multitasking to embedded applications.
CO7: Design and develop integrated embedded system applications using modern development tools and debugging techniques.