CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY
KANPUR

SYLLABUS

Integrated M.Sc. Electronics.
(VLSI & IoT System)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY
SCHOOL OF ENGINEERING & TECHNOLOGY

UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY
SCHOOL OF ENGINEERING & TECHNOLOGY

Vision

To achieve excellence in engineering education, empower students to be technically competent professionals and entrepreneurs with strong ethical values so as to significantly contribute as agents for universal development and societal transformation

Mission

To provide affordable quality education at par with global standards of academia and serve society with harmonious social diversity

To encourage new ideas and inculcate an entrepreneurial attitude amongst the students, and provide a robust research system

To practice and encourage high standards of professional ethics and accountability among students

Integrated M.Sc. Electronics
(VLSI & IoT System)

Program Outcomes (POs)

PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for engineering problems & design system components or processes that meet the specified needs with appropriate consideration for the public health, safety, and cultural, societal, and environmental considerations.
PO4	**Conduct investigation of complex problems:** Use research -based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create , select , and apply appropriate techniques , resources , and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO-1	To be able to understand problem, think of best suitable approach to solve the problem, develop and evaluate effective solutions as per the local/ regional/ national/ global requirements and availability of resources/ technologies.
PSO-2	To be able excel in contemporary technologies being adopted by the industry and academia for providing sustainable solutions
PSO-3	To be able to excel in various signal processing concepts/project competitions and technological challenges laid by professional bodies

Program Educational Outcomes (PEOs)

PEO-1	**Circuit Design Concepts:** Apply basic and advanced electronics for implementing and evaluating various circuit configurations.
PEO-2	**VLSI and Signal Processing Domain:** Demonstrate technical competency in the design and analysis of components in VLSI and Signal Processing domains globally.
PEO-3	**Communication Theory and Practice:** Possess application-level knowledge in theoretical and practical aspects required for the realization of complex communication systems.

Integrated M.Sc. Electronics

(Specialization in VLSI and IoT System)

(Under NEP–2020)

Course Structure

First Year

First Semester

Course Code	Courses	Credit	Internal	External	Marks
IME-101	Fundamental of Semiconductor Materials and Devices	4	25	75	100
IME-102	Mathematics-I	4	25	75	100
IME-103	Basic Electrical Engg.	4	25	75	100
IME-104	Programming in C++	4	25	75	100
IME-105(L)	C++ Programming Lab	2	15	35	50
IME-106(L)	Basic Electrical and PCB Lab	2	15	35	50
		20	**Total**		**500**

Second Semester

Course Code	Courses	Credit	Internal	External	Marks
IME-201	Electromagnetic Field Theory	4	25	75	100
IME-202	Basic Electronics and Measuring Instruments	4	25	75	100
IME-203	Network Analysis and Synthesis	4	25	75	100
IME-204	Digital Electronics	4	25	75	100
IME-205(L)	Instrumentation and Measurement Lab	2	15	35	50
IME-206(L)	Digital Electronics Lab	2	15	35	50
		20	**Total**		**500**

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Second Year

Third Semester

Course Code	Courses	Credit	Internal	External	Marks
IME-301	Mathematics-II	4	25	75	100
IME-302	Analog Electronics	4	25	75	100
IME-303	Signals and Systems	4	25	75	100
IME-304	Minor Elective – I*	4	25	75	100
IME-305(L)	Analog Electronics Lab	2	15	35	50
SSI-306	Summer Internship	2	15	35	50
		20	**Total**		**500**

***Departmental/ MOOCs**

Minor Elective – I*

1. Environmental Studies
2. Physics

Fourth Semester

Course Code	Courses	Credit	Internal	External	Marks
IME-401	Principle of Analog and Digital Communication	4	25	75	100
IME-402	Numerical Methods	4	25	75	100
IME-403	Fundamental of VLSI Technology	4	25	75	100
IME-404	Analog Integrated Circuits	4	25	75	100
IME- 405(L)	Analog and Digital Communication Lab	2	15	35	50
IME-406(L)	Analog Integrated Circuits Lab	2	15	35	50
		20	**Total**		**500**

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Third Year

Fifth Semester

Course Code	Courses	Credit	Internal	External	Marks
IME-501	Transducers and Sensors	4	25	75	100
IME-502	Introduction to IoT	4	25	75	100
IME-503	Antenna and Wave Propagation.	4	25	75	100
IME-504(L)	Transducers and Sensors Lab.	2	15	35	50
IME-505(L)	IoT Lab.	2	15	35	50
SSI-506	Summer Internship	2	15	35	50
SSM-507	Seminar	2	15	35	50
		20	Total		**500**

Six Semester

Course Code	Courses	Credit	Internal	External	Marks
IME-601	Advanced Semiconductor Devices	4	25	75	100
IME-602	Optical Communication	4	25	75	100
IME-603	Elective-I *	4	25	75	100
IME-604(L)	Optical Communication Lab	2	15	35	50
PRT-605	Project	6	50	100	150
		20	Total		**500**

***Departmental/ MOOCs**

Elective-I -

1. CMOS Digital VLSI Design
2. RTL Design and Synthesis
3. Bio-Medical Instrumentation.

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Fourth Year

Seven Semster

Course Code	Courses	Credit	Internal	External	Marks
IME-701	Advanced Microprocessor	4	25	75	100
IME-702	Advanced Analog and Digital Communication	4	25	75	100
IME-703	Advanced Instrumentation	4	25	75	100
IME-704(L)	Microprocessor Lab	2	15	35	50
IME-705(L)	Instrumentation Lab	2	15	35	50
SSM-706	Seminar	4	25	75	100
		20	Total		**500**

Eight Semester

Course Code	Courses	Credit	Internal	External	Marks
IME-801	VLSI Technology and Design	4	25	75	100
IME-802	Analog Integrated Circuits Design	4	25	75	100
IME-803	Minor Elective – II*	4	25	75	100
IME-804	Control System	4	25	75	100
IME-805(L)	VLSI design Lab	2	15	35	50
IME-806(L)	AIC Lab	2	15	35	50
		20	Total		**500**

***Departmental/ MOOCs**

Minor Elective – II*

1. Python Programming
2. Data Base Management System

Fifth Year

Ninth Semster

Course Code	Courses	Credit	Internal	External	Marks
IME-901	Micro Sensor Design	4	25	75	100
IME-902	IoT and its Application*	4	25	75	100
IME-903	Wireless Communication	4	25	75	100
IME-904(L)	IoT application Lab	2	15	35	50
IME-905(L)	Wireless Communication Lab	2	15	35	50
PRT-906	Dissertation-I	4	25	75	100
		20	Total		**500**

Tenth Semester

Course Code	Courses	Credit	Internal	External	Marks
IME-1001	Embedded System	4	25	75	100
IME-1002	Elective-II*	4	25	75	100
IME-1003	Digital Signal Processing	4	25	75	100
IME-1004(L)	Digital Signal Processing Lab	2	15	35	50
PRT-1005	Dissertation-II	6	50	100	150
		20	Total		**500**

***Departmental/ MOOCs**

Elective-II (Departmental/ Other Departments)

IME-1002(1). Python Programming
IME-1002(2) Java Programming
IME-1002(3). Artificial Intelligence
IME-1002(4). Machine Learning

Course Code : **IME-101**
Course Name : **Fundamentals of Semiconductor Materials and Devices**

Course Outcomes (COs)	
CO1:	Understand major properties of semiconductor materials, explain energy band diagrams and connections with the device structures and properties;
CO2:	Understand and utilize the basic governing equations to analyze semiconductor devices; design semiconductor devices and calculate device characteristics;
CO3:	Quantitatively evaluate limitations in design of circuits based on specific semiconductor devices;
CO4:	Understand and outline major steps of semiconductor device fabrication and microelectronic industry trends.

Unit 1: Semiconductor Basics: Energy band in solids (metal, semiconductor and insulators), concept of effective mass, direct bandgap and indirect bandgap semiconductors, density of states, carrier concentration at normal equilibrium in intrinsic semiconductors, mobility, drift & diffusion current, Fermi level, Hall effect.

Unit 2: Diode: p-n junction diode, formation of depletion layer, space charge at a junction, derivation of electrostatic potential difference at thermal equilibrium, depletion width and depletion capacitance of abrupt p-n junction, diode equations and the I-V characteristic, Zener and avalanche mechanism, Zener diode, Tunnel diode, Varactor diode, clipper circuits, clamping circuits, rectifier.

Unit 3: Bipolar Junction Transistor (BIT): PNP and NPN transistor, basic transistor action, energy band diagram of transistor in thermal equilibrium, early effect, input and output characteristics of CB, CE and CC configurations, faithful amplification, transistor as an amplifier, emitter fallower, CE amplifier: Self bias arrangement of CE, de and ac load line analysis Uni-junction Transistor (UJT) - Construction, working and I-V characteristics of UJT.

Unit 4: Field Effect Transistor (FET): Construction of JFEET, idea of channel formation, pinch-off voltage, Transfer and output characteristics. MOSFET: MOS Diode, Basic construction of MOSFET and working, I-V characteristics, enhancement and depletion modes, Complimentary MOS (CMOS).

Unit 5: Optoelectronic Devices: Photovoltaic effect, the p-n junction solar cell, I-V characteristics, photodetectors : photoconductor, photodiode, avalanche photodiode, LEDs, radiative and non-radiative transitions, semiconductor LASERS, population inversion.

Text Book / References

[1] S.M.Sze, Semiconductor Devices: Physics and Technology, John wiley & Sons.
[2] Ben Streetman and S.Banerjee, Solid State Electronic Devices, Pearson Education (2006).
[3] Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001).
[4] Kanaan Kano, Semiconductor Devices: Pearson Education (2004).
[5] Robert F. Pierret, Semiconductor Devices: Fundamental, Pearson Education.
[6] Dennis Le Croissette, Transistors, Pearson Education.

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Course Code : **IME-102**
Course Name: **Mathematics-I**

Course Outcomes (COs)	
CO1:	Evaluate partial derivatives with its physical significance and expand functions of several variables.
CO2:	learn concepts of calculus of two or more variables
CO3:	Understand basic statistics and learn to find mean mode, median and standard deviation.
CO4:	Numerically solve various problems using standard methods

Unit 1: Limit, Continuity And Differentiation of Functions of Two Variable, Homogenous Functions and their Properties, Chain Rule, Jacobians, Taylors theorem for Two Variables, Extreme of functions of Two or More Variables, Lagrange's Method of Undetermined Coefficients.

Unit 2: Double and Triple Integrals, Change of Order of Integration Change of Variables, Gamma and Beta Function,

Unit 3: Gradient, Divergence, Curl and their Physical Meaning, Identities Involving Gradient, Divergence &
Curl, Line and Surface Integrals, Greens Theorem, Gauss Divergence Theorem and Stokes Theorem.

Unit 4: Rank and Inverse of a Matrix, Solution of System of Linear Equations, Different Types of Matrices and their properties, Diagonalization of Matrix, Eigen value and Eigen Vector, Cayley Hamilton Theorem.

Unit 5: Concept of Probability, Random Variables and Distribution Function, Binomial, Poisson and Normal Distribution and their properties.

Text Book / References

[1] Higher engineering mathematics - Jain, jyenger & jain

[2] Higher engineering mathematics - B.S. Grewal

[3] Higher engineering mathematics - H.K.Dass

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Course Code : **IME-103**
Course Name : **BASIC ELECTRICAL ENGINEERING**

Course Outcomes (COs)	
CO1:	Understand the basic properties of electrical elements.
CO2:	To solve DC circuit analysis problems.
CO3:	Understand the fundamental behaviour of AC and DC circuit network theorems and solve AC circuit problems.
CO4:	Understand the knowledge gained to explain the behaviour of the circuit at series & parallel resonance of circuit & the effect of resonance.
CO5:	Understand the fundamental knowledge of Transformer. Understand the fundamental knowledge of DC Machines.

Unit 1: Network Theory & Concept Network Theory: Circuit theory concept, KVL & KCL, mesh analysis & nodal analysis. Network Theorems – Superposition Theorem, Thevenin's Theorem, Norton Theorem, Maximum power transfer Theorem, Miller's Theorem, star delta transformation.

Unit 2: AC Circuit Analysis Sinusoidal steady state circuit analysis, voltage, current, sinusoidal & phaser presentation single phase AC circuit – behavior of resistance, inductance & capacitance & their combination, Active power & Reactive power, power factor. Series & parallel resonance, bandwidth & quality factor.

Unit 3: Three phase circuits Phase voltage & current, line & phase quantities, phasor diagram, balanced & unbalanced loads, Measurement of R, L, and C. Three phase balanced circuits, voltage and current relations in star and delta connections.

Unit 4: Magnetic circuit & Transformer Magnetic circuit concepts: self inductance & mutual inductance. Transformer: Introduction to transformer, Principle & Construction of the Transformer, Types of the Transformer, EMF equation, Power loss, Efficiency and Regulation of the transformer, Transformer Tests- Open circuit test and Short circuit test, Auto Transformer, Three Phase Transformer

Unit 5: DC machines DC Motor: Principle of operation of the Motor, Types of the Motor, EMF equation and torque equation of motor, Losses and Efficiency DC Generator: Principle & Construction of the Generator, Types of the Generator, EMF equation of the Generator, Losses and Efficiency

Text Book / References

[1] I.J. Nagarath, " Basic Electrical Engineering" Tata McGraw Hill
[2] D.E. Fitzgerald & A. Grabel Higginbotham, " Basic Electrical Engineering Mc- Graw Hill
[3] Edward Hughes, " Electrical Technology" Longman
[4] T.K. Nagsarkar & M.S. Sukhija, "Basic Electrical Engineering" Oxford University Press. 3.
[5] H. Cotton, " Advanced Electrical Technology" Wheeler Publishing
[6] W.H. Hayt & J.E. Kennely, "Engineering Circuit Analysis" Mc Graw Hill.

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Course Code: IME-104
Course Name: PROGRAMMING IN C++

Course Outcomes (COs)	
CO1:	To explore the principles of Object Oriented Programming (OOP).
CO2:	To use the object-oriented paradigm in program design
CO3:	To lay a foundation for advanced programming.
CO4:	Provide programming insight using OOP constructs

Unit 1: Introduction: Object oriented programming, characteristics of an object-oriented language. C++ programming language: Tokens, keywords, identifier and constants, basic data types, user defined data types, derived data types, arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, bit wise operators, special operators, expressions and evaluation of expressions, scope resolution operator.

Unit 2: Decision making, Branching and Looping: if, if-else, else-if, switch statement, break, continue and go to statement, for loop, while loop and do loop.Functions: Function definition, function arguments and passing, returning values from functions, referencing arguments, function overloading, virtual functions,

Unit 3: Classes and Objects: Classes and objects, member functions, class constructors and destructors, array of objects, operator overloading.Class inheritance: Derived class and base class, multiple inheritance, polymorphism.

Unit 4: Streams in C++ - Stream Classes - Formatted and Unformatted data - Manipulators - User Defined Manipulators. Library functions, local, static and global variables. Arrays, pointers and structures

Unit 5: File Streams - Opening and Closing a File - File Pointers Manipulation - Template Classes and Functions- Exception Handling: Try, Catch. Exception Handling- Multithreading- Applets - Graphics Programming.

Text Book / References

[1] Object- Oriented Programming with C++" by Balagurusamy E,TMH Pub.
[2] PROGRAMMING IN C++" by P.B.MAHAPATRA, S Chand Pub.
[3] Programming with C++" by Ravichandran,TMH Pub.
[4] Data structures using C and C++" by Yedidyah,Moshe, and Aaron, PHI Pub.
[5] Data structure, Algorithms & application in C++" by SartajSahni ,McGrawHiIIPub

Course Code : IME-105(L)
Course Name : PROGRAMMING IN C++ Lab

LIST OF EXPERIMENTS

1. Write a program for Arithmetic operation
2. Write a program to find the factorial of given number and Fibonacci series using switch command.
3. Write a program to find greatest and smallest elements in an array.
4. Write a program to short array elements in descending order.
5. Write a program for sorting name in alphabetical order.
6. Write a program to print the diagonal matrix.
7. Write a program to find multiplication.
8. Write a Program to find a row sum and column sum of a given matrix.
9. Write a program to read and print two dimensional matrix find sum of diagonal.

Note: 20% experiments other than this list of equal standard relevant to syllabus can also be set.

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Course Code : IME-106(L)
Course Name : BASIC ELECTRICAL ENGINEERING & PCB Lab

LIST OF EXPERIMENTS

1. To verify KCL and KVL.
2. To measure single phase power.
3. To verify Superposition theorem.
4. To verify the Maximum Power Transfer Theorem.
5. To perform open circuit test on a single phase transformer.
6. To perform short circuit test on a single phase transformer.
7. Introduction to circuit creation and simulation.
8. Introduction to layout tool and creating layout board.
9. Design a half wave and full wave rectifier circuit.
10. Mini Project.

Note: 20% experiments other than this list of equal standard relevant to syllabus can also be set.

16.6.23

Course Code : **IME-201**
Course Name : **Electromagnetics Field Theory**

Course Outcomes (COs)	
CO1:	To differentiate different types of coordinate systems and use them for solving the problems of electromagnetic field theory.
CO2:	To describe static electric and magnetic fields, their behaviour in different media, associated laws, boundary conditions and electromagnetic potentials.
CO3:	To use integral and point form of Maxwell`s equations for solving the problems of electromagnetic field theory
CO4:	To describe time varying fields, propagation of electromagnetic waves in different media, pyonting theorem, their sources & effects and to apply the theory of electromagnetic waves in practical problems.

Unit 1: Electrostatic: Vector analysis: Vector algebra, Coordinate system and Transformation, Vector calculus Electrostatic Fields: Coulomb's law and field intensity, Electric field due to continuous charge distributions, Electric Flux density, Gauss's Law, Application of Gauss's law, Electric Potential, relationship between E and V, An electric dipole and flux lines, Energy density in Electrostatic Field. Electric Field in Material Space: Convection and conduction current, Polarization in Dielectric, Continuity Equation and Relaxation time, Boundary Conditions. Electrostatic boundary value problems: Poisson's and laplace's equations, Uniqueness theorem, Resistance and capacitance, Method of images

Unit 2: Magnetostatic: Biot-Savart's law, Ampere Circuital Law, Application of Ampere's Circuital law, Magnetic Flux density, Magnetic scalar and vector potentials, Force due to magnetic fields, Magnetic torque and moment, a Magnetic Dipole, Magnetization in Material, Classification of Magnetic material, Magnetic boundary conditions, Inductor and inductances, Magnetic Energy, Magnetic circuits.

Unit 3: Maxwell's Equation and Electromagnetic Waves Faraday's Law, Transformer and Motional EMFs, Displacement Current, Maxwell's Equation. Electromagnetic wave, Wave propagation in lossy dielectric, Plane waves in Lossless Dielectrics, Free Space, Good conductor, Power and the Poynting vector, Reflection of a plane wave at normal incidence, reflection of plane waves at oblique incidence

Unit 4: Rectangular Waveguides, Transmission lines, Transmission line parameters, Transmission line equations, Input impedance, SWR and Power, Smith chart, Applications

Text Book / References

[1] Matthew N.O.Sadiku -'Element of electromagnetic' -3e,Oxford University Press
[2] W.H.Hayt,J.A.Buck, M Jaleel Akhtar-'Engineering Electromagnetics'-8e,McGraw Hill.
[3] S Salivahanan, S.Karthie-'Electrmagnetic Field Theory' -2e, McGraw Hill.
[4] Joseph A. Edminister -'Schaum's series-Theory and problem of Electromagnetics' TMH
[5] David J.Griffith,-'Introduction to Electrodynamics'-3e, PHI.
[6] S.C.Mahapatra and Sudipta Mahapatra,-'Principle of electromagnetics' -2e, McGraw Hill

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Course Code : **IME-202**
Course Name : **Basic Electronic and Measuring Instruments**

Course Outcomes (COs)	
CO1:	Understand the Electrical measurement techniques and classical measuring instruments
CO2:	Modern measurement techniques and instruments
CO3:	Brief concepts of sensors and transducers
CO4:	Applications of the concepts of electrical and electronic measurement systems in special purpose measurements including magnetic measurements.

Unit 1: Measurements: introduction, Significance of measurements, methods of measurements, instruments and measurement systems, Functions of instruments and measurement systems, Applications of measurement systems. Measurement Errors: Introduction Gross errors and systematic errors, Absolute and relative errors, basic concepts of accuracy, Precision, Resolution and Significant figures, Measurement error combinations. (Relevant problems), static and Dynamic characteristics of instruments

Unit 2: Galvanometer, DC ammeter principle only, DC voltmeter, Multi-range voltmeter, extending voltmeter ranges, Loading, Peak responding and True RMS voltmeters. (Relevant problems) Digital Voltmeters: Introduction, Ramp type, Dual slope integrating type (V–T), integrating type (V–F) and Successive approximation type (relevant problems). Digital Instruments: Introduction, Block diagram of a Basic Digital Multimeter. Digital frequency meters: Basic circuit of a Digital frequency meter, Basic circuit for frequency measurement.

Unit 3: Oscilloscopes: Introduction, Basic principles, CRT features, Block diagram and working of each block, Typical CRT connections, Dual beam and dual trace CROs, Electronic switch.

Unit 4: Signal Generators: Introduction, Fixed and variable AF oscillator, Standard signal generator, Modern laboratory signal generator, AF sine and Square wave generator, Function generator, Square and Pulse generator.

Unit 5: Bridge Circuits for Measurement of R, L & C: DC bridges: Introduction, Wheatstone's bridge, Kelvin Bridge AC bridges: Capacitance Comparison Bridge, inductance Comparison Bridge, Maxwell's bridge, Schering Bridge. (Relevant problems)

Text Book / References

[1] "Electronic Instrumentation", H. S. Kalsi, TMH.
[2] "Electronic Instrumentation and Measurements", David A Bell, PHI / Pearson Education2006/ Oxford Higher Education.
[3] Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), DhanpatRai& Co. Pvt. Ltd.
[4] "Principles of Measurement Systems", John P. Beately, 3rdEdition, Pearson.
[5] "Modern Electronic Instrumentation and Measuring Techniques", Cooper D & Helfrick, PHI.

Course Code : **IME-203**
Course Name : **Network Analysis and Synthesis**

Course Outcomes (COs)	
CO1:	Understand the concept of graph theory using different analysis methods
CO2:	Apply different network functions for the analysis of electrical networks
CO3:	Understand the concept of two port networks
CO4:	Understand the properties of network functions
CO5:	Explain about the fundamental and types of filter

Unit 1: Network Fundamentals and Graph Theory- circuit theory concept, mesh & nodal analysis, star,delta conections and their transformation, Network theorems - Thevenin's, Norton, maximum power transfer theorem, twigs and links, trees, co-trees, formation of incidence matrix .cut-set matrix, tie-set matrix and loop currents, analysis of networks ,network equilibrium equation ,duality, network transformation.

Unit 2: Networks and Laplace Transform- Network equation, formulation of network equations, initial conditions in networks and network solution with Laplace transformation, step, ramp and impulse functions, initial and final value theorem and convolution integral. Transform impedance and transform circuits, duality, Fourier transform, discrete and continuous spectrum, relation and Laplace transforms.

Unit 3: Network Function- Network function for one-port and two-port, calculation of network function for ladder and general networks, poles and zeros with restrictions for driving point functions and transforin functions, two-port parameters, stability by Routh-Harwitz criterion.

Unit 4: Two Port Network Analysis-Two port networks, Two port parameters, Inter-conversion of 2 port parameter,network function- Driving point and transfer function, Inter-connections of 2 port networks, reciprocity ladder networks, Image impedance, Characteristic impedance.

Unit 5: Network Synthesis- Identification of network synthesis, Brune's positive and real function (PRF), properties of PRF, testing of driving point functions, even and odd function, one terminal pair network driving point synthesis with LC elements, RC elements, Foster and Cauer form.

Text Book / References

[1] "Introduction to Network Synthesis", Valkenburg, PID Phs.
[2] Sudhakar, A. Shyammohan, "Circuits and Network", Third Edition, 2006, TMH.
[3] Kelkar, Pandit, "Linear Network Theory", Pratibha Publication.

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Course Code : **IME-204**
Course Name : **Digital Electronics**

Course Outcomes (COs)	
CO1:	Understanding of the fundamental concepts and techniques used in digital electronics.
CO2:	To understand and examine the structure of various number systems and its application in digital design
CO3:	Understand, analyze and design various combinational and sequential circuits
CO4:	Ability to identify basic requirements for a design application and propose a cost effective solution.

Unit 1: Number system: Number systems, conversion of number systems,Binary arithmatics- addition, substraction, multiplication and division, 1's compliment and 2' complement,subtraction using 2's compliment method using 2's compliment , 9's compliment and 10's compliment, subtraction using 10's compliment method.

Unit 2: Boolean algebra and logic circuits- Boolean algebra- Boolean theorems, minimization of Boolean functions, basic logic gates, universal gates, minturm and maxterm, k-map, Boolean functions realization using logic gates, logic gate characteristics, logic families-RTL,DTL,TTL,ECL,CMOS.

Unit 3: Combinational circuits- Design of Binary adder, Subtractor, Parallel binary adder subtractor Circuit, BCD adder, decoders, multiplexer, de-multiplexers & their applications, Digital Comparators,Parity generator , error detection and corraction code,hamming codes, BCD to Seven segments decoder, Memory- write operation,read operation, types of memory-RAM ROM PROM EPROM and EEPROM.

Unit 4: Sequential circuits: introduction to sequential logic, Flip-Flops-RS Flip-Flop, D Flip-Flop, T Flip-Flop, JK flip-flop, Excitation and characteristics table of Flip-Flops, characteristics equation, Conversion of one form of Flip-Flops to another type, race around condition, Master slaves, flip-flop clocked sequential circuits, Multivibrator.

Unit 5: Counter and shift register: Design of Asynchronous & Synchronous counters - Ripple counter and Up-down Counters, shift registers, Serial & parallel data transfer.

Text Book / References

[1] Morris Mano, "Digital Design" PHI
[2] "Digital Integrated Circuit" A.K.Gautam-Katson Publication.
[3] Taub and Schilling "Digital Integrated Electronics",TMH
[4] Gopalan, K. "Gopal" / "Introduction To Digital Microelectronic Circuits" / TMH
[5] Millman, Jocob & Taub, Herbert / "Pulse, Digital & Switching Waveforms" / TMH
[6] Malvino, A.P. & Leach, Donald P. / "Digital Principles & Applications" / TMH

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Course Code : IME-205(L)
Course Name : Instrumentation and Measurement Lab

LIST OF EXPERIMENTS

1. To verify balance condition of wheatstone bridge using Multisim
2. To determine the galvanometer current under unbalanced condition of wheatstone bridge using Multisim
3. To verify balance condition of Maxwell's bridge using Multisim.
4. To verify balance condition of Hay's bridge using Multisim.
5. To verify balance condition of Schering bridge using Multisim
6. To verify balance condition of Wein's bridge using Multisim
7. To design square wave generator using Multisim
8. To design triangular wave generator using Multisim
9. To design sawtooth wave generator using Multisim
10. To design Function generator using Multisim

Note: 20% experiments other than this list of equal standard relevant to syllabus can also be set.

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Course Code: IME-301
Course Name: Mathematics-II

Course Outcomes (COs)	
CO1:	Knowledge and practices of2nd order differential equation and higher order differential equations with constant coefficients.
CO2:	Knowledge and practices of functions of complex variables and theorems.
CO3:	Knowledge and practices of taylor's and laurent, series and fourier sine & cosine integrals.
CO4:	Understand the Fourier sine & cosine integrals and Fourier Transform.

Unit 1: Solution of 2nd Order Differential Equation with Constant Coefficient, Euler Cauchy Equation, Method of Variation of Parameters, Matrix Method for Higher Order Differential Equations with Constant Coefficients.

Unit 2: Functions of Complex Variables, Analytic Function, Cauchy-Riemann Equation, Harmonic Functions, Harmonic Conjugate and Methods of finding it.

Unit 3: Cauchy's Integral theorem, Cauchy's Integral formula, Derivation of Analytic Function, Power Series Representation of Analytic Function, Radius Of Convergence. Taylor's and Laurent, Series, Singularities, Residue theorem, Evaluation of real integrals.

Unit 4: Fourier series and its Convergence, Fourier Series of Even & Odd functions, Half Range Sine and Cosine Series, Parsevals Identity, Complex Form of Fourier Series.

Unit 5: Fourier Integral, Fourier Sine & Cosine Integrals, Fourier Transform and their Elementary Properties, Convolution Theorem, Application to Boundary Value Problem.

Text Book / References

[I]. Higher engineering mathematics-Jain,jyenger & jain
[2]. Higher engineering mathematics-B.S. Grewal
[3]. Higher engineering mathematics-H.K. Dass
[4]. Higher engineering mathematics-V. Rammana

Course Code: IME-302
Course Name: Analog Electronics

Course Outcomes (COs)	
CO1:	Understand about diodes and dc load line, clipper and clamper circuits and working of rectifiers.
CO2:	Design and analysis of CE, CB, CC amplifiers using small signal h-model and pi-model and derivation of voltage gain, current gain, input impedance and output impedance.
CO3:	Design and analysis of negative feedback amplifiers and oscillators.
CO4:	Design and analysis of common source FET amplifier and its frequency response and MOSFET.

Unit 1: Diode circuits: Ideal diode, piecewise linear equivalent circuit, dc load line analysis, Quiescent(Q) point, Positive, negative and biased clipper circuits, clamping circuits, Half wave rectifier, centre tapped and bridge full wave rectifiers, Efficiency and ripple factor.

Unit 2: DC power supply: Block diagram of a power supply, qualitative description of shunt capacitor filter, Zener diode as voltage regulator, Basic construction and Characteristics of Thyristor, SCR, Characteristic and two transistor model of SCR.

Unit 3: The BIT, hybrid parameters, regions of operation, dc load line, Q point. CE amplifier, Self bias arrangement of CE, dc and ac load line analysis, Quantitative study of the frequency response of CE amplifier, effect on gain and bandwidth for cascaded CE amplifier (RC coupled) RC coupling, transformer coupling, Power Amplifiers: A, B, C and AB.

Unit 4: Feedback Amplifiers, Concept of feedback, Negative feedback: advantages and disadvantages of negative feedback, voltage (series and shunt), current (series and shunt), feedback amplifiers, derivation of gain, input and output impedances for feedback amplifiers. Barkhausen criteria for oscillations, phase shift oscillator and Colpitts oscillator.

Unit 5: The MOSFET: The three configurations: Common Gate, Common Source and Common Drain, I-V characteristics, regions of operation, small signal equivalent circuit, dc loadline, Q point, CS amplifier circuit analysis, Frequency response of CS amplifier.

Text Book / References

[1] R.L.Boylestad,L.Nashelsky,K.L.Kishore,Electronic Devices and Circuit theory, Pearson Edu.

[2] D.L.Schilllingand C.Belove,Electronic Circuits:Discrete and Integrated,Tata McGraw hill.

[3] R.C.Jaegarand T.N.Blalock, Microelectronic Circuit Design, Tata McGraw Hill

[4] Donald A.Neamen, Electronic Circuit Analysis and Design, Tata McGrawHill

[5] J.Millmanand C.C.Halkias, Integrated Electronics, Tata McGrawHill

Course Code: IME-303
Course Name: Signals and Systems

Course Outcomes (COs)	
CO1:	Understand mathematical description and representation of continuous and discrete time.
CO2:	Understand the concept of sampling and Effect of sampling, Continuous and discrete time signals.
CO3:	Understand and resolve the signals in frequency domain using Fourier series and Fourier transform.
CO4:	Understand the basic concept of probability, random variables & random signals and develop the ability to find correlation, CDF, PDF and probability of a given event.

Unit 1: Introduction to signals, Periodic & non periodic, Analog & digital, deterministic & random, energy & power signals. Fourier analysis: Fourier series representation of periodic signals, Fourier transform & their properties, singularity function, Application of Fourier transform for analysis of LTI, Impulse response of LTI system, discrete Fourier transform, DFT as a linear transformation,

Unit 2: Magnitude phase representation of Fourier transform, frequency response of LTI systems, time domain properties of ideal frequency selective filters, Time domain and frequency domain aspects of non ideal filters.

Unit 3: Random variable, random process. Correlation function (auto & cross) cumulative distribution function. Probability density function, joint cumulative & distribution and probability density.

Unit 4: Sampling theorem, reconstruction of signals from samples. Effect of sampling, Continuous and discrete time signals, Transformation of the independent variable. Continuous and discrete time systems. Basic system properties.

Unit 5: Region of convergence, Properties of the Z transform, Inverse transform using counter integration, Complex convolution theorem, Parseval's relation. Unilateral Z transform and its application to difference equation.

Text Book / References

[1] A.V.Oppenphim, A.S.Willsky and S.H.Nawab; signals and systems, prentice Hall.

[2] B.P.Lathi, Signal and system, Oxford university press , New Delhi.

[3] Roberts, M.J. / "Signals and Systems" / Tata McGraw-Hill

[4] Chen 'Signals & Systems, Oxford University, Press.

Minor Elective –I

Course Code: IME-304
Course Name: Environmental Studies

Course Outcomes (COs)	
CO1:	Understand the concepts and definitions associated with ecosystems, environmental pollution and its causes.
CO2:	Gain knowledge to analyze problems and suggest alternatives and new methods to manage natural resources.
CO3:	Understand how to Redesign, Recreate & Restore the ecosystems.
CO4:	Understand the legal aspects and the role of government in environment protection.

Unit 1: Scope and Importance of environmental studies, Need for public awareness, Segments of environment, biodiversities: Genetic diversity, Species diversity, Ecosystem diversity, Landscape diversity, Causes of pollution and detrimental effects.

Unit 2: Eco systems- Types of systems, energy flow in an ecosystem, Balanced ecosystem, Human activities- Food, shelter, economic and social security, Effects of human activities on environment- Agriculture, housing, Industry, mining and transportation activities, Basics of Environmental Impact Assessment, Sustainable Development.

Unit 3: Types of natural resources: Water resources-Availability and quality aspects, Water borne diseases, Fluoride problems in portable water, Mineral resources, Food resources, Land resources, Forest Wealth, Material cycles- Carbon, Nitrogen and Sulphur cycle.

Unit 4: Energy- Different types of energy (Renewable and Non-renewable), Convectional and non- conventional energy-sources Electromagnetic radiation, Hydro Electric, Fossil fuel based, Nuclear, Solar, Biomass and Bio-gas, Hydrogen as an alternative source of energy.

Unit 5: Environmental pollution and their effects, Water pollution, Land pollution, Noise pollution, public Health aspects, Air pollution, Current environmental issues of Population Growth, Climate change and global warming effect. Preventive measures and control of pollution, Air and Water pollution control, Sold waste management, Case studies

Unit 6: Role of Government in environment protection, Legal Aspects, Initiatives and protection Acts, public awareness.

Text Book / References

[1]. Environmental Studies- Benny Joseph, TMH, Third edition.

[2]. Environmental Studies- Dr. D.L. Manjunath, pearson Education, 2022.

[3]. Environmental Studies- R. Rajgopalan, Oxford publication.

COURSE CODE: Elective - I

COURSE NAME: PHYSICS

UNIT -I

Newton's Law of motion, Frame of reference, Inertial frame of reference, Non Intertial frame of reference, Michelson Morley
Experiment, Lorentz Transformation Einstein's postulates, Mass energy equivalence, Length Contraction, Time Dilation, Addition of velocities,variation of Mass with velocity.Moment of Inertia , Rotaional Energy for rotating bodies.

UNIT- II

Conservative and Non conservative force, Linear Momentum, Angular Momentum, Central force,Two body
Central force problem, reduced mass, relative and centre of mass, Law of gravitation, Kepler's law , Motion of Planets and Satellites.

UNIT- III

Simple Harmonic motion, Differential equation of SHM and its solution , damped and forced vibration , differential equation of wave motion , Plane Progressive Waves in fluid media, reflection of waves, phase change on reflection, superposition, stationary waves,pressure and energy distribution, phase and group velocity.

UNIT -IV

Thermometric , idial gas, kinetic theory gasses, r.m.s speed of molecule, specific heat of mono, di and tri atomic gasses,Adiabatic expansion, real gas, vander waal gas, equation of state , nature of vander waal forces, jule expansion of ideal gas and vander waal gas, Laws of thermodynamics , Zeroth law, first law of thermo dynamics, camot cycle and its efficiency. Carnot Theorem and second law of thermo dynamics.

UNIT -V

Black body radiation : Pure temperature dependence, Stefan Boltzmann law, Pressure of radiation, Spectral distribution of Black body radiation ,Wein's displacement law Rayleigh – Jean's law , Planck's law , KirchafPs law : absorption and emission.

References

1. Introduction to Mechanics – R.D. Kleppnar and J. Kalenkow
2. A text book of Mechanics – J. C. Upadhyay
3. Introduction to special theory of relativity – Robert Rasnick
4. Basic and applied Thermodynamics – Nag P.
5. Thermal Physics: with Kinetic theory, thermodynamics – S.C. Garg
6. Fundamentals of thermodynamics 7th edition – Claus Borgnakke

Course Code: IME-305 (L)
Course Name: Analog Electronics Lab

List of Experiments

1) To measure DC/AC voltage and frequency using CRO and FG.

2) To obtain the static characteristics of a PN junction diode and then obtain the forward resistance of the diode at a given operating point.

3) To obtain V-I characteristics of a Zener diode and note down its breakdown potential.

4) Fabrication and testing of a half wave rectifier and observe the smoothing of the output using capacitor filter and ripple suppression using a Zener diode.

5) To bias a given transistor in active region in CE configuration.

6) Measurement of current gain Ai, Input impedance , and output impedance

7) CE amplifier and make the

- **a)** Upper cut off.
- **b)** Lower cut off frequencies and hence estimate the BW.

8) Bias a MOS transistor in saturation region in C-S configuration.

9) Bias a JFET in saturation region and operates it as an RC coupled amplifier in C-S configuration and measure the voltage gain.

Note: 20% experiments other than this list of equal standard relevant to syllabus can also be set.

Course Code : IME-401
Course Name: Principle of Analog and Digital Communication

Course Outcomes (COs):	
CO1:	Understand the basic concepts of the analog communication systems and evaluate modulation index, bandwidth and power requirements for various analog modulation schemes including AM,FM and PM.
CO2:	Understand and Analyze various analog continuous wave modulation and demodulation techniques including AM, FM and PM.
CO3:	Understand the basics of information theory, source coding techniques and calculate Entropy of source and knowledge of ASK,FSK, PSK.
CO4:	Study about the error detection and correction.

Unit 1: Information, Message and Signal, Elements of communication System and its Fundamental limitations, Need of Modulation, amplitude modulation, Time domain representation of AM signal, Spectrum of AM signal, Power and current relations in AM, Generation and Demodulation of DSB-SC, SSB-SC and VSB-SC.

Unit 2: Types of Angle Modulation, Mathematical Representation of Frequency and Phase Modulation, Concepts of Instantaneous frequency, WBFM and NBFM, Pre-emphasis and De-emphasis in FM, Generation and Demodulation of FM, External and internal sources of noise, Thermal noise, Shot noise, Noise figure, Noise temperature, Equivalent noise bandwidth.

Unit 3: Sampling process, sampling theorem, signal reconstruction, flat top sampling of band pass signals, Analog Pulse Modulation, Types of analog pulse modulation, Method of Generation and Demodulation of PAM,PWM,PPM, Spectra of pulse modulation, concept of pulse code modulation(PCM),generation and demodulation of PCM, DPCM demodulation, TDM .

Unit 4: Elements of Digital communication and information theory Model of a digital communication system, Digital Data transmission, Line coding review, Pulse shaping, Scrambling, Digital receivers, Method of generation and detection of coherent & non-coherent binary ASK, FSK & PSK, Differential phase shift keying, Quadrature modulation techniques.

Unit-5: Hamming sphere, hamming distance and Hamming bound, relation between minimum distance and error detecting and correcting capability Linear block codes: encoding and syndrome decoding. Cyclic codes, Convolution codes, code tree and Trellis diagram.

Text Book / References

[1]. Communication Systems: S.Haykin, JohnWilly Sons.

[2]. Communication Systems: A.B.Carlson, McGrawHill

[3]. Modern Analog &Digital Communication Systems: B.P.Lathi; OxfordUniv. Press.

[4]. Analog Communication Systems: P.chakrabarti, Dhanpat Rai.

Course Code: IME-402
Course Name: Numerical Methods

Course Outcomes (COs):	
CO1:	Learn how to obtain numerical solution of nonlinear equations using Bisection, Newton – Raphson and fixed-point iteration methods.
CO2:	Solve system of linear equations numerically using direct and iterative methods.
CO3:	Understand the methods to construct interpolating polynomials with practical exposure.
CO4:	Analyze the different samples of data at different level of significance using various hypothesis testing.

Unit 1: Introduction: Numbers and their accuracy, Computer Arithmetic, Mathematical preliminaries, Errors and their Computation, General error formula, Error in a series approximation Solution of Algebraic and Transcendental Equation: Bisection Method, Iteration method, Method of false position, Newton-Raphson method, Methods of finding complex roots, Muller's method, Rate of convergence of Iterative methods, Polynomial Equations.

Unit 2: Interpolation: Finite Differences, Difference tables Polynomial Interpolation: Newton's forward and backward formula Central Difference Formulae: Gauss forward and backward formula, Stirling's, Bessel's, Everett's formula. Interpolation with unequal intervals: Langrange's Interpolation, Newton Divided difference formula, Hermite's Interpolation,

Unit 3: Numerical Integration and Differentiation: Introduction, Numerical differentiation Numerical Integration: Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Boole's rule, Waddle's rule.

Unit 4: Solution of differential Equations: Picard's Method, Euler's Method, Taylor's Method, Runge-Kutta Methods, Predictor Corrector Methods, Automatic Error and Stability of solution

Unit-5: Statistical Computation: Frequency chart, Curve fitting by method of least squares, fitting of straight lines, polynomials, exponential curves etc, Data fitting with Cubic splines, Regression Analysis, Linear and Non linear Regression, Multiple regression, Statistical Quality Control methods.

Text Book / References

[1]. Rajaraman V, "Computer Oriented Numerical Methods", Pearson Education
[2]. Gerald &Whealey, "Applied Numerical Analyses", AW
[3]. B.S.Grewal,"Numerical Methods",Khanna pub.
[4].R.K.Jain and S.R.K.Iyenger, "Numerical Methods",New Age International (P) Ltd. Pub.

Course Code: IME-403
Course Name: Fundamental of VLSI Technology

Course Outcomes (COs):	
CO1:	Understand the basic steps of fabrication.
CO2:	Learn the basics theory of Crystal Growth and Wafer Preparation.
CO3:	Study the Epitaxy, Diffusion, Oxidation, Lithography and Etching
CO4:	Understand the basic theory of MOS transistors.

Unit 1: Monolithic Integrated Circuits, Bipolar and MOS Integrated Circuits, Electronic Grade Silicon, CZ Crystal Growing Process, Silicon Shaping, Processing Consideration., Growth Mechanism, Silicon Wafer Characterization, Crystal Purification Techniques.

Unit 2: Models of Diffusion in Solids, Fick's One Dimensional Diffusion Equations, Atomic Diffusion Mechanisms, RangeTheory, Ion Implantation process, Importance of Ion Implantation process, Annealing, Oxidation, Oxide Properties, Thin and Thick Oxides Thermal oxidation, Properties of oxide Layer, Oxidation Induced Defects.

Unit 3: Lithogrphy, Photoresistmaterials, Photomasking, Photolithography, Optical Lithography, Electron Lithography, X-Ray Lithography, Ion-BeamLithography, Techniques for Pattern Transfer, Etching Process, Etch Mechanisms, Wet Chemical Etching, Reactive Plasma Etching Techniques and Equipment, Degree of Anisotropy, Metallization, Materials properties for Metallization.

Unit 4: Epitaxy, Vapour Phase Epitaxy, Molecular Beam Epitaxy, Liquid Phase Epitaxy, Epitaxial Reactors, Physical Vapour Deposition, Evaporation Systems, Sputtering, Chemical vapour deposition (CVD), CVD Reactors.

Unit 5: Thick film hybrid IC, Advantages and applications of Thick films, Thick film substrates, Thick film dielectrics and resistors, Thin film hybrid Ic's, Advantages and applications of Thin films, Thin film processing, Thickness measurement,1-Vmeasurement,C-Vmeasurements, Resistance measurement–two probe and four probe.

Text Book / References

[1]. "VLSITechnology"byS.M.Sze, McgrawHillPub.
[2]. "Solid State Electronic Devices"byBen G.Streetman, PHIPub.
[3]. "Physics and Technology of Semiconductor Devices"byA.S.Grove, JohnWileyandSonsPub.
[4]. "Large Scale Integration"byMJ. Howerand D.V.Morgan,JohnWileyPub.
[5]. "Semiconductor & Integrated FabricationTechniques" byP.E.GiseandR. Blanchard, Rn Pub.

Course Code: IME-404

Course Name: Analog Integrated Circuits

Course Outcomes (COs)	
CO1:	Develop skills to design simple circuits using OP-AMP.
CO2:	Gain the knowledge about Multi-vibrator, Multiplexer and instrumentation Amplifiers.
CO3:	Learn about various techniques to develop A/D and D/A convertors.
CO4:	Gain the knowledge of 555 timer IC and its applications and also PLL.

Unit 1: Brief review of differential amplifier, current mirror, active load, level shifter, output stage; ac and dc characteristics. Basic building blocks of OP – AMPS.

Unit 2: Inverting /Non-inverting VCVS, Integrators, Differentiators, CCVS and VCCS, instrumentation Amplifiers, bi-quad filter (LP, HP, BP and Notch), Oscillators. Logarithmic amplifiers, Precision rectifier, peak detector, sample and hold circuits. OP – AMP as comparator, Schmitt trigger, square and triangular wave generator, Monostable Multi-vibrator, IC Analog Multiplexer and De-multiplexer.

Unit 3: Transistorized series-pass Regulator, Overload short circuit and Thermal shut-down protection, OP – AMP Regulators, IC Regulators, fixed voltage regulators (78/79, XX), 723 IC Regulators (Current limiting, Current fold back); SMPS.

Unit 4: Analog to digital & DAC, weighted resistor & binary ladder D/A converters, single & dual slope integration, counter, successive approximation, resistor type A/D converters.

Unit 5: IC timer (555) applications monostable and astable operation. Ramp Generator: Triangle generator, Saw-tooth generator.**PLL :** Principle, definition and applications, Linear model of PLL, phase detectors, voltage controlled oscillators, loop filters, FM demodulation, using PLL digital PLL steady state.

Text Book / References

[1] Sedra Smith Microelectronics/Oxford Universities Press.

[2] Gayakwad/OP Amps and Linear Integrated circuits/PHI.

[3] C.S. Socl of/Application of analog Integrator circuits/PHI.

[4] D. P. Singh /semiconductor devices and circuits /Dhanpat Rai & Co.

[5] Jacob applications & Design with analog Ics/PHI 1996.

Course Code: IME-405(L)
Course Name: Analog and Digital communication Lab

List of Experiments:

1. Generation of AM Signal and measurement of Modulation Index.
2. Generation & Detection of DSB-SC, SSB Signal.
3. To study the Varactor modulator.
4. Detection of SSB signal
5. Generation of NB FM Signal.
6. Generation of FM Signal
7. Sample and hold circuit.
8. PAM, PWM, PPM generation and detection.
9. Delta modulation and detection.
10. Pulse data coding and decoding techniques for NRZ formats
11. ASK, FSK, PSK modulation and detection
12. Single bit error detection and correction.
13. PCM Modulation and detection

Note: 20% experiments other than this list of equal standard relevant to syllabus can also be set.

Course Code: IME-406(L)
Course Name: Analog Integrated Circuits Lab

List of Experiments:

1. Measurement of Op-amp Parameters. (Gain, Input offset Voltage, CMRR, Slew rate).
2. Determination of Frequency response of Op-Amp.
3. Op Amp as Adder, Subtractor & Integrator, Instrumentation Amplifier
4. Precision Rectifier.
5. Instrumentation Amplifier.
6. Open Loop operation of Op-amp -Comparators - Schmitt Trigger.
7. Astable & Monostable Operation Using 555.
8. IC Voltage Regulator.
9. Voltage Controlled Oscillator.
10. Phase Locked Loop.
11. Frequency Multiplier.
12. A/D Converters & D/A Converters.
13. Second Order Active Filter- High Pass & Low Pass Realization.

Note: 20% experiments other than this list of equal standard relevant to syllabus can also be set.

Course Code: IME-501

Course Name: Transducers and Sensors

Course Outcomes (COs)	
CO1:	Use concepts in common methods for converting a physical parameter into a electrical & non-electrical quantity
CO2:	Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light
CO3:	Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
CO4:	Predict correctly the expected performance of various sensors

Unit 1: Transducer for measurement of non-electrical quantities temperature transducer, Pressure Transducers, Force Transducers, Liquid level Transducers, Flow transducers

Unit 2: Passive Electrical Transducers: Resistive- Resistance Thermometers, Resistive displacement Transducers, Resistive strain Transducers, Resistive Pressure Transducers. Inductive- Inductive thickness transducers, Inductive displacement transducers, Eddy current type Inductive transducers. Capacitive- Capacitive thickness Transducers, Capacitive displacement Transducers

Unit 3: Active Electrical Transducers: Thermo electric Transducers, Piezo-electric Transducers- Force transducers, strain transducers, Torque and pressure transducers, and photoelectric transducers. Digital Transducers- Digital displacement transducers, Digital tachometers.

Unit 4: Sensor Characteristics Transfer Function : Mathematical Model, Functional Approximations, Polynomial Approximations, Sensitivity, Linear Piece wise Approximation, Calibration, Computation of Transfer Function Parameters, Linear Regression, Computation of Stimulus, Computation from Linear Piece wise Approximation , Iterative Computation of Stimulus (Newton Method) , Span (Full-Scale Full Scale Input) , Full-Scale Output, Accuracy, Calibration Error, Hysteresis , Non linearity, Saturation, Repeatability , Dead Band , Resolution, Output Impedance , Output Format, Excitation, Dynamic Characteristics, Environmental Factors ,Reliability , Application Characteristics , Uncertainty .

Unit 5: Sensors: Occupancy and Motion Detectors, Position, Displacement, and Level sensors, Velocity and Acceleration sensors, Force, Strain, and Tactile Sensors, Pressure Sensors, Acoustic Sensors, Humidity and Moisture Sensors, Light Detectors, and Radiation Detectors, Temperature Sensors

Textbook:

[1]. Hand book of Micro Sensor, Physics, Designs, and Applications Fourth Edition, Jacob Fraden, Springer.

[2]. DVS Murty, Transducers, PHI

Course Code: IME-502
Course Name: Introduction to IoT

Course Outcomes (COs)	
CO1:	Known basic protocols in sensor networks.
CO2:	Program and configure Arduino boards for various designs.
CO3:	Python programming and interfacing for Raspberry Pi.
CO4:	Design IoT applications in different domains

UNIT–1: Introduction to Internet of Things, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks.

UNIT–2: Machine-to-Machine Communications, Difference between IoT and M2M, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino,

UNIT–3: Introduction to Python programming, Introduction to Raspberry Pi, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi

UNIT – 4: Implementation of IoT with Raspberry Pi, Introduction to Software defined Network (SDN), SDN for IoT, Data Handling and Analytics,

UNIT–5: Cloud Computing, Sensor-Cloud, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring

TEXT BOOKS:

[1]. "The Internet 'of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)

[2]. "Make sensors": Terokarvinen, kemo, karvinen and villey valtokari, 1st edition, maker media,2014.

[3]. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti

REFERENCE BOOKS:

[1]. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach"

[2]. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

[3]. Beginning Sensor networks with Arduino and Raspberry Pi – Charles Bell, Apress,

Course Code: **IME-504(L)**

Course Name: **Transducers and Sensors Lab**

List of Experiments

[1]. AnalogtoDigitalconvertor
- a. To verify the characteristics of counter type ADC.
- b. To verify the characteristics of SAR type ADC.

[2]. To verify the characteristics of Load Cell.
[3]. To verify the characteristics of Strain Gauge
[4]. To verify the characteristics of Linear variable Differential Transformer (LVDT).
[5]. To verify the characteristics of Water Level Transducer.
[6]. Study of Optical Transducer
- a. To study the characteristics of Filament Lamp.
- b. To study the characteristics of Photovoltaic Cell.
- c. To study the characteristics of Photo conductive cell.
- d. To study the characteristics of PIN Photo diode.
- e. To study the characteristics of phototransistor.

[7]. Study of Temperature Transducer
- a. To study the characteristics of IC temperature sensors.
- b. To study the characteristics of Platinum RTD.
- c. To study the characteristics of NTC thermistor.
- d. To study the characteristics of NTC Bridge Circuit.
- e. To study the characteristics of K type Thermocouple.

Note: 20% experiments other than this list of equal standard relevant to syllabus can also be set.

Course Code: **IME-505(L)**

Course Name: **Introduction to IoT Lab**

List of Experiments:

1. Connection of an Arduino board with ESP8266 wifi module.
2. IoT based control of an LED using Arduino.
3. IoT and cloud based data logger using LM35 and Arduino.
4. IoT based home automation using Arduino.
5. IoT based street light control using Arduino.
6. IoT based DC motor speed control using Arduino.

Note: 20% experiments other than this list of equal standard relevant to syllabus can also be set.

Course Code: **IME-601**

Course Name: **Advanced Semiconductor Devices**

Course Outcomes (COs)	
CO1:	Ability to analyse and describe the PN junctions in semiconductor devices and the behavior of various special purpose diodes.
CO2:	Ability to understand and analyse the, structure, behaviour and various models of BJT, FET and MOSFET circuits.
CO3:	Demonstrate the switching and amplification Application of the semiconductor devices.
CO4:	Recognize the role power electronics play in the improvement of energy usage efficiency and the applications of power electronics in emerging areas.

UNIT-1: Junction Theory: Abrupt and Graded PN junction, Ion implanted junction, Epitaxial junction. Equilibrium conditions, contact potential, current flow at a junction, junction breakdown, capacitance of p-n junctions, charge storage and transient behaviour, rectifiers, Zener diode, Metal-Semi conductor contact, Energy band diagrams, Schottky effect,Varactor diodes.

UNIT-2: Bipolar Junction Transistor: BJT-General characteristics, Ebers-moll Model, Specification for switching transistors, thermal effects, kirk effects, transit effects, Webster Effect, Heterojunction Bipolar transistors.

UNIT-3: Field Effect Transistors: The junction FET, MESFET, MOSFET basic device Characteristics with analysis, the ideal MOS capacitor, threshold voltage, V-I characteristics of MOS gate oxides, output characteristics, transfer characteristics, Mobility Model power MOSFETS, CMOS structure.

UNIT-4: Micro wave and Opto Electronic Devices: Transferred Electron Model, Principle, structure, construction and working of Gunn diodes, READ diode, IMPATT, TRAPATT. Optical absorption, Luminescence, photo luminescence and electro luminescence, Photodiode, solar cell, Phototransistor & LEDs, Semiconductor lasers, Heterojunction laser operating principles.

UNIT-5: Power Electronic Devices: The p-n-p-n diode, SCR, GTO, IGBT, MCT, DIAC, TRAIC-operations and characteristics.

RECOMMENDED BOOKS:

[1]. "Solid State Electronic Devices" by Ben G Streetman, Pill Pub.
[2]. "Semiconductor Devices -Physics and Technology" by S M Sze, John Wiley Pub.
[3]. "Semiconductor Devices" by Kanaan Kano, Pearson Education.
[4]. "Microwave Devices and circuits" by Samuel Y. Liao, PHI Pub.
[5]. "Semiconductor Physics and Devices-Basic Principles" by Donald A Neamen, TMH Pub.
[6]. "Power Semiconductor drives" by S. B. Dewan, G. R. Sleman and A. Strauphan, John Wiley Sons.
[7]. "Power Electronics" by P. C. Sen, TMH Education.

Course Code: IME-602
Course Name: Optical Communication

Course Outcomes (COs)	
CO1:	Transmission Characteristics of fiber like attenuation and dispersion. Analyse various coupling Losses.
CO2:	Principle and operation of the optical sources and detectors such as LASER, LED& APD.
CO3:	Optical Amplifier: The basic concepts of optical networks, Describe about the SONET/SDH, WDM.
CO4:	Familiar with Design considerations of fibre optic systems, OTDR. Non communicational applications of optical fibre

UNIT-1: Introduction: Historical developments, Optical fiber communication system, Principle of optical communication, Advantages of optical fiber communication, Total internal reflection. Acceptance angle, Numerical aperture, Skew rays, cylindrical fiber. Structure and types of optical cable: Structure of optical fibers, Single and rnultirnode fibers, Step index and graded index optical fiber. Optimized fiber structures.

UNIT-2: Transmission Characteristics of Optical Fibers: Mid-infrared and Far-infrared transmission, Inter-modal and Intra-modal dispersion. Over all fiber dispersion, Polarization. Losses in optical fibers- Attenuation, Material absorption losses, Linear scattering losses, Non-linear scattering losses and Fiber bends loss and Joint loss. Preparation methods of optical fibers- Liquid phase (melting) and Vapour phase deposition techniques. Plasma enhanced chemical vapour deposition method. Powel launching and coupling Source to fiber power launching, power calculation, leasing schemes, fiber to fiber joints. fiber splicing technique, fiber connectors.

UNIT-3: Optical sources & Optical detectors: Absorption and emission of radiation, Einstein's relation, Population inversion. Optical emission from semiconductors, Semiconductor LASER, LED structures, LED characteristics. Optical detection: principles, Absorption and emission, characteristics: Quantum efficiency. Responsivity. p-n photo diode, p-i-n photo diode. Avalanche photo diodes, photo transistors.

UNIT-4: Digital Transmission Systems: Point to point links, system considerations, link power budget. Rise time budget, modulation formats for analog communication system, introduction to WDM concepts. Introduction to advanced multiplexing strategies.

RECOMMENDED BOOKS:

[1]. "Optoelectronics: An introduction "by J. Wilsonand, J. F. B. Haovkes, PHI Pub.
[2]. "Optical Fiber Communication" by Gerd Keiser. TMH Pub.
[3]. "Optical fiber communication principle and practice" by John M. Senior PHI Pub.

Course Code: IME-603(3)

Course Name: Biomedical Instruments

Course Outcome:

CO1	Having understanding of different bioelectric potential and electrodes
CO2	Understanding cardiovascular system and its measurements
CO3	Understanding respiratory system and its measurement.
CO4	Having knowledge of diagnostic techniques, biotelemetry, Patient care and monitoring system.

Course Details:

Unit I

Introduction: The age of Biomedical Engineering, Development of Biomedical Instrumentation, Man–Instrumentation system, Components, Physiological system of the body, Problem encountered in measuring a living system.

Transducers & Electrodes: The Transducers & Transduction principles, Active transducers, Passive Transducers, Transducer for Biomedical Applications.

Unit II

Sources of Bioelectric potentials: Resting & Action potentials, propagation of active potential, The Bioelectric potentials-ECG, EEG, EMG, and Invoked Responses

Electrodes: Electrode theory, Bio potential Electrodes–Microelectrodes Body surface electrodes, Needle Electrodes, Biochemical Transducers, Reference electrodes, PH electrodes, Blood Gas electrodes.

Unit III

Cardiovascular Measurements: Electrocardiography – ECG amplifiers, Electrodes & leads, ECG recorders - Three channel, Vector Cardiographs, ECG system for stress testing, Continuous ECG recording (Holter recording), Blood pressure measurement, Blood flow measurement, Heart sound measurements.

Patient Care & Monitoring- Elements of Intensive Care monitoring, patient monitoring displays, Diagnosis, Calibration & Reparability of patient monitoring equipment, pacemakers & Defibrillators.

Unit IV

Measurements in Respiratory system: Physiology of respiratory system Measurement of breathing mechanics- Spiro meter.

Respiratory Therapy equipment: Inhalators ventilators & Respirators, Humidifiers, Nebulizers & Aspirators.

Diagnostic Techniques: Ultrasonic Diagnosis Echocardiography, Echo Encephalography, Ophthalmic scans, X-Ray & Radio-isotope Instrumentation, Computerized Axial Tomography Scanners

Unit V

Bio Telemetry: The components of Biotelemetry System Implantable units, Telemetry for ECG measurements during exercise, for Emergency patient monitoring. Physiological Effects of Electric Current Safety of Medical Electronic Equipment, Shock hazards from Electrical equipment and prevention against them.

Text Books:

1. Cormwell / "Biomedical Instrumentation and Measurements"/ Prentice Hall (India).

Reference Books:

1. Khandpur R.S./ "Biomedical Instrumentation"/ Tata McGraw-Hill.
2. Tompkins / "Biomedical DSP: C Language Examples and Laboratory Experiments for the IBM PC"/ Prentice Hall (India).

Course Code: **IME-604(L)**
Course Name: **Optical Communication Lab**

LIST OF EXPERIMENTS

[1] .To Study an 950mm Fibre Optic Link and Relationship b/w Input and output.

(a)-Analog link
(b)-Digital link
(c)-Voice link

[2]. Measurement of bending Losses in Optic Fibre with given Wavelength.

[3]. Measurement of Numerical Aperture and V number of given Fibre.

[4]. Study of Frequency Modulation and Demodulation over Fibre Optic Link.

[5]. Study the Characteristic of Fibre Optic LED and Detector.

[6]. Study of Pulse Position Modulation and Demodulation over Fibre Optic Link.

[7]. Study of pulse Width Modulation and Demodulation over Fibre Optic Link

Advance Experiment

[8]. Study the OTD Randits Graph.

[9]. Measurement of Transmission Characteristic of Optical Fibre link Using OTDR.

Note: 20% experiments other than this list of equal standard relevant to syllabus can also be set

Course Code : **IME-701**
Course Name : **Advanced Microprocessor**

Course Outcomes(COs)	
CO1:	Understand the necessity, features and architecture of 8085.
CO2:	Understand the necessity, features and architecture of 8086.
CO3:	To analyse the addressing modes and understand the functions of 8086 instructions.
CO4:	Explain the architecture and features of microcontroller.

Unit 1: Microprocessor and Microcomputer Introduction, Digital computer, computer language, Microprocessor architectures and operation, Microcomputer system, memory, Types of memory, Read operation & Write operation, Interfacing of Memory with Microprocessor.
8085 Microprocessor Architecture Introductions, internal Architecture of 8085, pins out configuration, instruction fetch, execute & decode operation, timing diagram.

Unit 2: Advance 16 bit Microprocessor (8086) Introduction of 8086, Internal organization of 8086, Bus Interface Unit, Execution Unit, Maximum and Minimum mode, Address and data bus Register Organization, Memory Segmentation, Adder Unit, Program Status Word, Addressing modes.

Unit 3: Instruction set and Assembly Language programming Introduction, instruction and data formats, addressing modes, status flags, Data Transfer Instruction sets, Arithmetic & Logical Instruction sets, Stack related Instruction sets, Subroutine Instruction sets, I/O related Instructions, Machine control Instruction sets. Programming techniques, data transfer with 8 bit & 16 bit, Arithmetic operation related to memory, Logical operation programs, Stack related programs, Subroutine programs Interrupts Hardware and software interrupts, interrupt call location, Interrupt related programs, Additional I/O concepts and processes.

Unit 4: Programmable peripheral interfacing devices Programmable peripheral interface (8255) - Architecture of Programmable peripheral interface, Operating modes of 8255, Interfacing of 8255 with Microprocessor, Interfacing of seven segment display with Microprocessor via 8255, Interfacing of ADC with Microprocessor via 8255.

Unit-5 :Introduction to Microcontroller 8051 : The 8051 Architecture, configuration, I/O port Structure, registers, memory organization ,Instruction set, Basic Assembly language programming concept.

Text Book / References

[1] R.S. Gaonkar; Microprocessor Architecture, Programming and Applications –New age International
[2] D.V.Hall Microprocessors and interfacing –TMH
[3] Brey barry; the Intel Microprocessor –PHI

Course Code: IME-702
Course Name: Advanced Analog and Digital Communication

Course Outcomes(COs)	
CO1:	Basic working of communication system
CO2:	Explain sampling, PCM, delta modulation, adaptive delta modulation and superheterodyne receiver.
CO3:	Demonstrate generation and detection of analog and digital modulation techniques.
CO4:	Apply time division multiplexing concepts in different pulse modulation techniques.

Unit1: Need of modulation, modulation, types of modulation, amplitude modulation, generation and demodulation of DSBSC and SSBSC, power requirements, noise performance in different AM modulation systems, frequency modulation, WBFM & NBFM, generation and demodulation of FM. power requirement in FM, noise performance in different FM modulation systems.

Unit2: Pulse analog modulation, generation and demodulation of PAM, PWM, PPM, comparisons of PAM/PWM/PPM, sampling theorem, pulse code modulation, transmitter and receiver of PCM, application of PCM, quantisation noise in PCM, encoding.

Unit3: Wave form coding technique: Discretization in time and amplitude, Linear quantizer, quantization noise power calculation, signal to quantization noise ratio, non-uniform quantizer, differential pulse code modulation, Delta modulation, noise and slope over load, Adaptive delta modulation, adaptive DPCM. Comparison of PCM and DM.

Unit4: Elements of Digital communication and information theory Model of a digital communication system, logarithmic measure of information, entropy and information rate, conditional entropy and redundancy, source coding fixed and variable length code words, Source coding theorem, prefix doing and craft inequality, Mutual information and channel capacity of a discrete memory less channel, of a BSC, Hartley Shannon law.

UNIT5: Fundamentals of probability theory & random process: Concept of Probability, Random variable, Statistical averages, Correlation, Sum of Random Variables, Central Limit Theorem, Random Process, Classification of Random Processes Power spectral density.

Text Book / References

[1] Taub & Schilling/"Principles of Communication Systems"/TMH.
[2] Kennedy, George& Davis, Bernard " Electronic communication systems" TMH.
[3] Singh, R .P. & Sapre, S.D. " Communication Systems: Analog & Digital" TMH.

Course Code: IME-703
Course Name: Advanced Instrumentation

Course Outcomes(COs)	
CO1:	Discover key IoT concepts including identification, sensors, localization, wireless protocols, data storage and security
CO2:	Explore IoT technologies, architectures, standards, and regulation.
CO3:	Realize the value created by collecting, communicating, coordinating, and leveraging the data from connected devices
CO4:	At the end of the program, students will be able to understand how to develop and implement their own IoT technologies, solutions, and applications.

Unit 1: Introduction & Architecture: IoT and the connected world. The difference between IoT and its Architecture, IOT node, Challenges of IOT. Fundamentals of Control System, introductions, components, closed loop & open loop system.

Unit 2: IOT Components: Introduction to Sensors (Description and Working principle): Types of sensors, working principle of basic Sensors -Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11). Digital switch, Electro Mechanical switches.

Unit 3: Communication Technologies of IoT: Communication Protocols: IEEE 802.15.4, ZigBee, Z Wave, Bluetooth, BLE, NFC, RFID Industry standards communication technology (LoRAWAN, OPC UA, MQTT), connecting into existing Modbus and wireless network communication.

Unit 4: Visualization and Data Types of IoT: Front-end EDGE devices, Enterprise data for IoT, Emerging descriptive data standards for IoT, Cloud database, Cloud computing, Fog or Edge computing. Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT.

Unit 5: Retrieving Data: Extraction from Web: Grabbing the content from a web page, Sending data on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M). Control & Supervisory Level of Automation: Programmable logic controller (PLC), Real-time control system, Supervisory Control & Data Acquisition (SCADA). HMI in an automation process, ERP & MES.

Text Book / References

[1] The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) (Springer Publication).
[2] Industrial Internet of Things: Cyber manufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication).
[3] Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun 1. Jerker Delsing, IoT Automation: Arrowhead Framework, CRC Press.

Course Code: IME-704(L)
Course Name: Microprocessor Lab

Course Outcomes(COs)	
CO1:	Set up programming strategies and select proper mnemonics and run their program on the training boards.
CO2:	Develop testing and experimental procedures on Microprocessor and Microcontroller analyze their operation under different cases
CO3:	Practice different types of programming keeping in mind technical issues and evaluate possible causes of discrepancy in practical experimental observations in comparison
CO4:	Primarily via team-based laboratory activities, students will demonstrate the ability to interact effectively on a social and interpersonal level with fellow students, and will demonstrate the ability to divide up and share task responsibilities to complete assignments.

LIST OF EXPERIMENT

1. To study the familiarization with ET-8085 AD kit.
2. Write an assembly language program to add two 32-bit no. present in memory from 2000H onward and 2100H onward and store maximum 33 bit result in memory from 2200H onwards.
3. Write an assembly language program to add four digit BCD no. which are stored from memory location 2000H onwards and store the maximum BCD result in the memory in sequence.
4. Write an ALP to perform subtraction of(X-Y) using 2's complement method where X and Y are two 16 bit numbers present in memory location from 2000H onwards in sequence. Store result in memory in sequence.
5. Write an ALP to multiply two 8 bit numbers which are present in memory 2000H and 2001H and store the result in memory in sequence.
6. 10 data bytes are store in memory location from 2000H onwards. Write an ALP to arrange the series in descending order.
7. 10 data bytes are store in memory location from 2000H onwards. Write an ALP to arrange the series in ascending order.
8. Write an ALP to generate a square wave of frequency 1KHZ.
9. Write a program to read an 8 –bit data from port A of 8255 and store it at location 2100H.
10. Write an ALP in 8086 to add two 8 bit numbers with carry.

Note: 20% experiments other than this list of equal standard relevant to syllabus can also be set.

Course Code : **IME-801**
Course Name : **VLSI Technology and Design**

Course Outcomes (COs)	
CO1:	Understand major properties of semiconductor materials, explain energy band diagrams and connections with the device structures and properties;
CO2:	Understand and utilize the basic governing equations to analyze semiconductor devices; design semiconductor devices and calculate device characteristics;
CO3:	Quantitatively evaluate limitations in design of circuits based on specific semiconductor devices;
CO4:	Understand and outline major steps of semiconductor device fabrication and microelectronic industry trends.

Unit 1: Crystal Growth & Wafer Characterization: Electronic Grade Silicon, CZ Crystal Growing, Silicon Shaping, Processing Consideration. Epitaxy: Vapor Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators. Oxidation: Growth Mechanism, Oxide Properties, Oxidation Induced Defects Lithography: Optical Lithography, Electron Lithography, X-Ray Lithography.

Unit 2: Diffusion: Models of Diffusion in Solids, Fick's One Dimensional Diffusion Equations, Atomic Diffusion Mechanisms Ion Implantation: Range Theory, Implantation Equipment, Annealing Metallization: Metallization Applications, Metallization Choice, Physical Vapour Deposition, Patterning, Bipolar IC Technology

Unit 3: Introduction to MOS: MOS, CMOS IC Technology, Metal Gate, Poly Silicon Gate, P-Channel, N- Channel Devices, Enhancement Mode and Depletion Mode Devices and their Characteristics.

Unit 4: VLSI design Introduction: Issues in Digital Integrated Circuit Design, Quality Metrics of a Digital Design. The Manufacturing Process: Manufacturing CMOS Integrated Circuits, Design Rules, IC Layout, Packaging Integrated Circuits, Spice Diode Model, MOSFET Transistors.

Unit 5: The CMOS Inverter: The Static CMOS Inverter, Performance of CMOS Inverter, Power, Energy and Energy Delay Designing Combinational Logic Gates in CMOS: Static CMOS Design, Dynamic CMOS Design, Simulation and Layout Techniques for Logic Gates Designing Sequential Logic Circuits: Static Latches and Register, Dynamic Latches and Register.

Unit 6: Architecture Design: VHDL, Register-Transfer Design, High Level Synthesis.

Text Book / References

[1] Rabaey, John.M. and Chandrakasan /"Digital Integrated Circuits ,A Design perspective" / Pearson Edu.
[2] Wayne,Wolf/"Modern VLSI Design- Systems on Silicon"/Addison-Wesley/3rdEd.2005
[3] Sze, S.M./ "VLSI Technology" / TMH
[4] Streetman,B.G.&Banerjee,Sanjay/"Solid State Electronic Devices" Prentice Hall (India)
[5] Kang ,Sun-moand Leblebici,Yusuf/"CMOS Digital Integrated Circuits ,Analysis &Design "/TMH
[6] Pucknell, Douglas A. and Eshraghian, Kamran/ "Basic VLSI Design"/ Prentice – Hall
[7] Razavi,Behzad/"Design of Analog CMOS integrated circuits"/TataMcGraw-Hill.-2003
[8] Weste,N.H.E.& Eshraghian ,K./"Principles of CMOS VLSI Design"/Pearson Education

Course Code : **IME-802**
Course Name : **Analog Integrated Circuits Design**

Course Outcomes (COs)	
CO1:	Understand the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.
CO2:	Explain and compare the working of multivibrators using special application IC 555 and general purpose amp.
CO3:	Classify and comprehend the working principle of data converters.
CO4:	Illustrate the function of application specific ICs such as Voltage regulators, PLL and its application in communication

Unit 1: Basic IC Op-Amp Fundamentals: Brief review of differential amplifier, current mirror, active load, level shifter, output stage; ac and de characteristics.

Unit 2: Inverting lNon-inverting VCVS, Integrators, Differentiators, CCVS and VCCS, instrumentation Amplifiers, bi-quad filter (LP, HP, BP and Notch), Oscillators. Logarithmic amplifiers, Precision rectifier, peak detector, sample and hold circuits. OP-AMP as comparator, Schmitt trigger, square and triangular wave generator, Monostable Multi-vibrator.

Unit 3: Voltage Regulators: Transistorized series-pass Regulator, Overload short circuit and Thermal shut- down protection, OP - AMP Regulators, IC Regulators, fixed voltage regulators (78/79, XX), 723 IC Regulators (Current limiting, Current fold back); SMPS.

Unit 4: Analog CMOS Design Introduction, MOSFET Small Signal Model, MOSFET as a Switch, MOS Diode/Resistor, Small Signal Analysis of Single Stage Amplifiers, MOS Current Source and Sink, Current Mirror, Resistor Realization Using Switched Capacitor, MOS Voltage and Current References,

Unit 5: Analog CMOS Design and its amplifier CMOS Amplifier, MOS Differential Amplifier, Cascode Amplifier, Current Amplifier,Output Amplifier, Source Follower, Voltage Level Shifter, CMOS Operational Amplifier. Comparator,Switched Capacitor Filter, Digital-to-Analog Converter, Analog-to-Digital Converter, Phase-locked Loop, Field Programmable Analog Array

Text Book / References

[1] Sedra Smith Microelectronics / Oxford Universities Press.

[2] Gayakwad/ OP Amps and Linear Integrated circuits / PHI. Fourth Edition

[3] C.S. Socl of / Application of analog Integratorcircuits / PHI.2011

[4] D. P. Singh / Semiconductor devices and circuits / Dhanpat Rai &Co.

[5] Jacob applications & Design with analog ICs / PHI.

Minor Elective -II

Course Code : **IME-803**
Course Name : **Python Programming**

Course Outcomes (COs)	
CO1:	Learn the syntax and semantics of Python Programming Language.
CO2:	Write Python functions to facilitate code reuse and manipulate strings.
CO3:	Illustrate the process of structuring the data using lists, tuples and dictionaries
CO4:	Demonstrate the use of built-in functions to navigate the file system.

Unit 1: Introduction, Python Basics: Entering Expressions into the Interactive Shell,The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program. Flow control: Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements,

Unit 2: Functions: def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling.

Unit 3: Dictionaries and Structuring Data: The Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things. Manipulating Strings-Working with Strings, Useful String Methods.

Unit 4: Pattern Matching with Regular Expressions: Finding Patterns of Text without Regular Expressions, Finding Patterns of Text with Regular Expressions,

Text Book / References

[1] Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Green Tea Press.

[2] Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley

[3] Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education

[4] Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, "Data Structures and

[5] Algorithms in Python", 1st Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126562176.

[6] ReemaThareja, "Python Programming using problem solving approach", Oxford

Course Code : **IME-804**
Course Name : **Control System**

Course Outcomes (COs)	
CO1:	Categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form.
CO2:	Characterize any system in Laplace domain to illustrate different specification of the system using transfer function concept.
CO3:	Interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis
CO4:	Employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions

Unit 1: Introduction to open loop and closed loop control systems. Mathematical representation of physical systems. Transfer functions block diagram and signal flow graph. Reduction algebra, masons gain. Time domain performance criterion, Transient response of first order, second order& Higher Order Systems.

Unit 2: Time domain analysis and Root Locus Techniques: Standard test signals, Time domain performance of control systems, Transient response of the first order system, the second order system, stability, steady state errors, effect of adding zero to the system, Proportional, derivative and integral controllers, combined controllers, Effect of integral and derivative control on system, performance, PID controller, performance indices.

Unit 3: Stability and Algebraic Criteria: Concept of stability and necessary conditions, Routh-Hurwitz criteria and limitations, Root Locus Technique: The root locus concepts, construction of root loci.

Unit 4: Frequency response, correlation between time and frequency responses, polar and inverse polar plots, Bode plots Stability in Frequency Domain: Nyquist stability criterion, assessment of relative stability: gain margin and phase margin, constant M&N circles.

UNIT 5: The design problem and preliminary considerations lead, lag and lead-lag networks, design of closed loop systems using compensation techniques in time domain and frequency domain. State Variable Analysis Review of state variable, state model, state model for linear continuous time system, diagonalization, solution of state equations, concept of controllability and observability.

Text Book / References

[1] Nagrath & Gopal, "Control System Engineering", New age International.
[2] K. Ogata, "Modern Control Engineering", Prentice Hall of India.
[3] B.C. Kuo & Farid Golnaraghi, "Automatic Control System" Wiley India Ltd.
[4] D.Roy Choudhary, "Modern Control Engineering", Prentice Hall of India.
[5] Norman S. Mise, Control System Engineering, Wiley Publishing Co.
[6] Ajit K Manda!, "Introduction to Control Engineering" New Age International.
[7] Samarjit Ghosh, "Control Systems theory and Applications", Pearson Education

Course Code : **IME-805(L)**
Course Name : **VLSI Design Lab**

Course Outcomes (COs)	
CO1:	Implementation of combinational and sequential circuits using CMOS logic.
CO2:	Analyze amplifier circuits.
CO3:	Design sequential circuits such as flip flop.
CO4:	Do the layout designing for physical analysis of the MOS transistor and MOS based circuits.

List of Experiments:

1. Design and implementation of Half adder and Full adder using CMOS logic.
2. To simulate the schematic of the common drain amplifier.
3. To simulate the schematic of the differential amplifier.
4. To simulate the schematic of the operational amplifier.
5. Design of 3-8 decoder using MOS technology.
6. Design a 4:1 Multiplexer.
7. Design and implementation of Flip flop circuit.
8. Layout design of PMOS, NMOS transistors.
9. Layout design of CMOS inverter and its analysis.

Note: 20% experiments other than this list of equal standard relevant to syllabus can also be set.

Course Code : **IME-806(L)**
Course Name : **Analog Integrated Circuits Lab**

Course Outcomes (COs)	
CO1:	Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques
CO2:	Explain and compare the working of multivibrators using special application IC 555 and general purpose amp.
CO3:	Classify and comprehend the working principle of data converters.
CO4:	Illustrate the function of application specific ICs such as Voltage regulators, PLL and its application in communication

List of Experiments:

1. Measurement of Op-amp Parameters.(Gain, Input offset Voltage, CMRR, Slewrate).
2. Determination of Frequency response of Op-Amp.
3. Op Amp as Adder, Subtractor & Integrator, Instrumentation Amplifier
4. Precision Rectifier.
5. Instrumentation Amplifier.
6. Open Loop operation of Op-amp-Comparators-Schmitt Trigger.
7. A stable & Mono stable Operation Using555.
8. IC Voltage Regulator.
9. Voltage Controlled Oscillator.
10. Phase Locked Loop.
11. Frequency Multiplier.
12. A/D Converters & D/A Converters.
13. Second Order Active Filter-High Pass & Low Pass Realization.

Note: 20% experiments other than this list of equal standard relevant to syllabus can also be set.

Course Code : IME-901
Course Name : Micro-Sensor Design

Course Outcomes (COs)	
CO1:	To understand the definition of micromachining and MEMS as well as an historical perspective of this emerging field.
CO2:	To understand the fundamental properties of materials used for MEMS devices
CO3:	To gain a comprehensive perspective of various physical mechanisms for MEMS design
CO4:	To understand the fundamental principle of piezo-resistive sensing, piezoelectric sensing, magnetostatic actuation and methods for fabricating
CO5:	To understand the principle and design of Polymer based MEMS, Optical MEMS, RF MEMS.

Unit 1: Introduction to MEMS and micro fabrication: History of MEMS development, characteristics of MEMS-miniaturization - micro Electronics integration -Mass fabrication with precision. Micro fabrication – micro electronics fabrication process- silicon based MEMS processes- new material and fabrication processing- points of consideration for processing.

Unit 2: Electrical and Mechanical properties of MEMS materials: Conductivity of semiconductors, crystal plane and orientation, stress and stain – definition – relationship between tensile stress and stain- mechanical properties of silicon and thin films, flexural beam bending analysis under single loading condition- types of beam- deflection of beam- longitudinal stain under pure bending spring-constant, torsional deflection, intrinsic stress, resonance and quality factor.

Unit 3: Sensing and actuation: Electrostatic sensing and actuation-parallel plate capacitor and its application and tactile sensor parallel Plate actuator- comb drive. Thermal sensing and actuations-thermal sensors-actuators and its applications. Piezoresistive sensors piezoresistive sensor material- stress in flexural cantilever and membrane and its application. Piezoelectric sensing and actuation- piezoelectric material properties-quartz-PZT-PVDF ZnO and its applications. Magnetic actuation- micro magnetic actuation principle- deposition of magnetic materials-design and fabrication of magnetic coil.

Unit 4: Polymer, RF and Optical MEMS:Polymers in MEMS- polymide-su-8 liquid Crystal polymer(LCP)-PDMS-PMMA-parylene- flurocorbon, application-acceleration, pressure, flow and tactile sensors. RF MEMS- Impedance tuners, Tunable filters, Phase shifters, Reconfigurable antennas Optical MEMS-passive MEMS Optical components-lenses-mirrors-actuation for active optical MEMS.

Text Book / References

[1] Chang Liu, Foundations of MEMS, Pearson International Edition, 2006.
[2] Gaberiel M.Rebiz, RF MEMS Theory,Design and Technology, John Wiley & Sons,2003
[3] Charles P.Poole, Frank J.Owens, Introduction to nanotechnology John Wiley & sons.
[4] Julian W.Gardner, Vijay K, Microsensors, MEMS and Smart devices, John. Wiley & sons, 2001.
[5] Stepan Lucyszyn, "Advanced RF MEMS", Cambridge University Press, 2010.

Course Code : **IME-902**
Course Name : **IoT and its Application**

Course Outcomes (COs)	
CO1:	Incorporate the best practices learnt to identify the attacks and mitigate the same.
CO2:	Adopt the right security techniques and protocols during the design of IoT products.
CO3:	Assimilate and apply the skills learnt on ciphers and block chains when appropriate.
CO4:	Describe the essential components of IoT.
CO5:	Find appropriate security/privacy solutions for IoT..

Unit 1: Fundamentals of IoT and Security and its need, Prevent Unauthorized Access to Sensor Data, Block ciphers, Introduction to Blockchain, Introduction of IoT devices, IoT Security Requirements, M2M Security, Message integrity, Modeling faults and adversaries, Difference among IoT devices, computers, and embedded devices.

Unit 2: IoT and cyber-physical systems RFID Security, Authenticated encryption Byzantine Generals problem sensors and actuators in IoT. IoT security (vulnerabilities, attacks, and countermeasures), Cyber Physical Object Security, Hash functions, Consensus algorithms and their scalability problems, Accelerometer, photoresistor, buttons.

Unit 3: Security engineering for IoT development Hardware Security, Merkle trees and Elliptic curves digital signatures, verifiable random functions, Zero-knowledge systems motor, LED, vibrator. IoT security lifecycle, Front-end System Privacy Protection, Management, Secure IoT Databases, Public-key crypto (PKI), blockchain, the challenges, and solutions, analog signal vs. digital signal.

Unit 4: Data Privacy Networking Function Security Trees signature algorithms proof of work, Proof of stake, Networking in IoT, Device/User Authentication in IoT IoT Networking Protocols, Crypto-currencies, alternatives to Bitcoin consensus, Bitcoin scripting language and their use Real-time communication.

Unit 5: Introduction to Authentication Techniques Secure IoT Lower Layers, Bitcoin P2P network, Ethereum and Smart Contracts, Bandwidth efficiency, Data Trustworthiness in IoT Secure IoT Higher Layers, Distributed consensus, Smart Contract Languages and verification challenges data analytics in IoT - simple data analyzing methods.

Text Book / References

[1] B. Russell and D. Van Duren, "Practical Internet of Things Security," Packt Publishing.
[2] FeiHU, "Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and R18", CRC Press.
[3] Narayanan et al., "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction," Princeton University Press, 2016.
[4] Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies," O'Reilly, 2014.
[5] T. Alpcan and T. Basar, "Network Security: A Decision and Game-theoretic Approach," Cambridge University Press, 2011.
[6] Security and the IoT ecosystem, KPMG International, 2015.
[7] Internet of Things: IoT Governance, Privacy and Security Issues" by European Research

Course Code : **IME-903**
Course Name : **Wireless Communication**

Course Outcomes (COs)	
CO1:	Gain knowledge of key concepts of wireless communication.
CO2:	Cellular concepts like frequency reuse, fading, equalization, GSM, CDMA.
CO3:	Apply the concept to calculate link budget using path loss model
CO4:	Measure capacity of AWGN channel, LTI Gaussian channels and various fading channels.
CO5:	To distinguish among different types of wave propagation

Unit 1: Introduction to wireless communication, A simplified reference model for mobile communications, Generations: 2G, 3G, 4G, 5G. Wireless LAN, Bluetooth and Personal Area networks, Broadband Wireless Access -- WiMAX Technology. Wireless Spectrum allocation, Standards. Frequency Reuse, channel assignment strategies, Handoff strategies, Interference and system capacity, trunking and grade off service, improving coverage and capacity – cell splitting, sectoring, microcells.

Unit 2: Wireless Channels: Path loss and shadowing-Free space path loss, Two-Ray model, Shadowing, Statistical Multipath Channel Models-Time-varying channel impulse response, Narrowband fading, Wideband fading models, Flat fading versus frequency selective fading, Slow fading versus fast fading, Discrete-time model, Capacity of Wireless Channels-Review of Capacity in AWGN, Capacity of flat fading channel.

Unit 3: Multi-carrier Modulation-Data transmission using multicarrier modulation for frequency-selective fading channels. Uplink and Downlink, Multiple Access, Frequency-Division Multiple Access (FDMA), Time-Division Multiple Access (TDMA), Code-Division Multiple Access (CDMA), Orthogonal Frequency-Division Multiple Access (OFDMA).

Unit 4: Data Transfer Techniques-Serial data transmission methods and standards RS 232- C: specifications connection and timing, LAN, Universal serial bus, HART protocol, Foundation -Fieldbus, ModBus, Zigbee and Bluetooth.

Unit 5: Ground wave propagation, Plane earth reflection, Space wave and surface wave, Spherical earth propagation, Tropospheric waves, Ionospheric propagation, Effects of earth's magnetic field, Critical frequency, Maximum usable Frequency, Virtual height.

Text Book / References

[1] T.S. Rappaport, "Wireless Communication-Principles and practice",Pearson-2010
[2] D. R. Kamilo Fehar, "Wireless digitalcommunication"Prentice Hall, May 1995
[3] Haykin S & Moher M., "Modern wireless communication", Pearson,2005.

Course Code : **IME-904(L)**
Course Name : **IoT Application Lab**

List of Experiments:

[1] Connection of an Arduino board with ESP8266 wifi module.

[2] IoT based control of an LED using Arduino.

[3] IoT and cloud based data logger using LM35 and Arduino.

[4] IoT based home automation using Arduino.

[5] IoT based street light control using Arduino.

[6] IoT based DC motor speed control using Arduino.

Note: 20% experiments other than this list of equal standard relevant to syllabus can also be set.

Course Code : **IME-905(L)**
Course Name : **Wireless Communication Lab**

List of Experiments:

[1] Selection and study of various PN code (MLS, GOLD, BARKER).

[2] Generate (spreading) DS-SS modulated signal.

[3] To demodulate (dispreading) DS-SS modulated signal.

[4] Selection & comparative study of various code modulation techniques: BPSK/ QPSK/ OQPSK.

[5] Modulation and Demodulation using internal generation of 2047 bit PN sequence as modulator Input and Unmodulated carrier.

[6] Spreading and Despreading using Additive white Gaussian Noise Generator and frequency offset.

[7] Voice communication using DSSS.

[8] To set up Active Satellite link.

[9] Study satellite transponder.

Note: 20% experiments other than this list of equal standard relevant to syllabus can also be set.

Course Code : **IME-1001**
Course Name : **Embedded System**

Course Outcomes (COs)	
CO1:	Acquire a basic knowledge about fundamentals of microcontrollers
CO2:	Acquire a basic knowledge about programming and system control to perform a specific task.
CO3:	Acquire knowledge about devices and buses used in embedded networking. Develop programming skills in embedded systems for various applications.
CO4:	Acquire knowledge about basic concepts of circuit emulators

Unit 1: Introduction to Embedded systems: Embedded systems, processor embedded into a system, embedded hardware units and devices in a system, embedded software in a system, embedded SOC and use of VLSI circuit design technology, Complex systems design and processors, Design process in embedded system, formalization of system design, design process, classification of embedded systems.

Unit 2: Microcontroller architecture: Review of 8051 architecture, 8051 registers, Memory organizations-program memory and data memory, internal RAM and bit addressable memory, special functions register. Interfacing 8051.

Unit 3: PIC Microcontrollers: PIC 16 Series family overview, an architecture overview of the 16F84A, Power-up and Reset, PIC 16F84A parallel ports, 16F84A clock oscillator, 16F84A operating conditions, 16F84A interrupt structure.
Larger systems and the PIC 16F873A: The main idea of PIC 16F87XA, 16F873A memory and memory maps, 16F873A interrupts, 16F873A oscillator, reset and power supply, 16F873A parallel ports.
ARM Embedded Systems: The RISC design philosophy, The ARM design philosophy, ARM processor fundamentals, LPC 214x microcontroller Features, architecture, Internal memory, system control, pin connect block, GPIOs, Timers, ADC, UART, CAN, I2C, Pulse Width Modulation, RTC, WDT.

Unit 4: Introduction to OS and Real Time Operating System: Overview of OS, Basic design using RTOS, Multi Systems, Processes and Threads, Operating system function, Features of an Operating System, Features of RTOS.

Text Books:

[1] Embedded Systems Architecture Programming and Design by Raj Kamal, II-edition, (TMH).
[2] Designing Embedded Systems with PIC Microcontrollers: principles and applications by Tim Wilmshurst, Elsevier.

Reference Books:

[1] Embedded System: Architecture, Programming and Design by Raj Kamal, 2nd Edition, TMH Publication.
[2] Real Times Systems Theory and Practice by Rajib Mall (Pearson Education)
[3] Embedded Real-time Systems Programming Sri Ram Iyer and Pankaj Gupta (TMH)
[4] Muhammad Ali Mazidi, Janice Gillispie Mazidi "The 8051 Microcontroller and Embedded Systems using Assembly and C ", 2nd Edition, Pearson education

Course Code : **IME-1002(1)**
Course Name : **Python Programming**

Course Outcomes (COs)	
CO1:	Learn the syntax and semantics of Python Programming Language.
CO2:	Write Python functions to facilitate code reuse and manipulate strings.
CO3:	Illustrate the process of structuring the data using lists, tuples and dictionaries.
CO4:	Demonstrate the use of built-in functions to navigate the file system.

Unit 1: Basics of Python Programming: Features of Python, variables and identifiers, operators and expressions. Decision control Statements: Selection/Conditional branching statements, basic loop structures/iterative Statements, nested loops, break, continue, and pass Statements. Functions and Modules: function definition, function call, more on defining functions, recursive functions, modules.

Unit 2: Data Structures: Strings: Introduction, built-in string methods and functions, slice operation, String Module. Regular Expressions. Lists: Introduction, nested list, cloning lists, basic list operations, list methods. Functional programming.

Unit 3: Tuples: Introduction, basic tuple operations, tuple assignment, tuples for returning multiple values, nested tuples, tuple methods and functions. Set: Introduction, Set operations. Dictionaries: Basic operations, sorting items, looping over dictionary, nested dictionaries, built-in dictionary functions.

Unit 4: Files and Exceptions: reading and writing files, pickling, handling exceptions. Built-in and user-defined exceptions. OOPS Concepts: Introduction, classes and object, class method and self argument, public and private data members, Inheritance, Operator Overloading.

Reference Books:

[1] Reema Thareja, Python programming using problem solving approach, Oxford University press.
[2] Allen Downey, Think Python: How to Think Like a Computer Scientist, O'Reilly publications, 2nd Edition.
[3] Albert Lukaszewski, Mysql for python, PACKT publishers
[4] Mark Lutz, "Learning Python", O'Reilly Publications.
[5] Stewart Venit and Elizabeth Drake, Prelude to Programming: Concepts and Design, 6th Edition (2015), Pearson.
[6] Mark J Guzdial, Introduction to Computing and programming in Python, 3rd Edition, Pearson.

Course Code : **IME-1002(2)**
Course Name : **Java Programming**

Course Outcomes (COs)	
CO1:	To become familiar with the features of Java Language
CO2:	Understand the concepts such as Classes, Objects, Inheritance, Polymorphism and Interfaces
CO3:	To learn Java APIs for Collections, I/O Streams
CO4:	To design GUI applications and Applets using AWT and Swing

Unit 1: Java Programming: Data types, control structured, arrays, strings, and vector, classes (inheritance, package, exception handling) multithreaded programming. Java applets, AWT controls (Button, Labels, Combo box, list and other Listeners, menu bar) layout manager, string handling (only main functions)

Unit 2: Networking (datagram socket and *TCP/IP* based server socket) event handling, JDBC: Introduction, Drivers, Establishing Connection, Connection Pooling.

Unit 3: HTML: use of commenting, headers, text styling, images, formatting text with, special characters, horizontal rules, line breaks, table, forms, image maps, tags, tags, file formats including image formats.

Unit 4: Java Servlets: Introduction, HTTP Servlet Basics, The Servlet Lifecycle, Retrieving Information, Sending HTML Information, Session Tracking, Database Connectivity

Unit 5: Java Server Pages: Introducing Java Server Pages, JSP Overview, Setting Up the JSP Environment, Generating Dynamic Content, Using Custom Tag Libraries and the JSP Standard Tag Library, Processing Input and Output.

Referential Books:

[1] Patrick Naughton and Herbertz Schildt, "Java-2 The Complete Reference" TMH.
[2] Shelley Powers, "Dynamic Web Publishing" 2nd Ed. Tech media.
[3] Ivor Horton, "Beginning Java-2" SPD Publication
[4] Jason Hunter, "Java Servlet Programming" O'Reilly
[5] Shelley Powers, "Dynamic Web Publishing" 2nd Ed. Tech media.
[6] Hans Bergsten, "Java Server Pages", 3 Ed. O'reilly

Course Code : **IME-1002(3)**
Course Name : **Artificial Intelligence**

Course Outcomes (COs)	
CO1:	Understand formal methods of knowledge representation
CO2:	Understand foundation principles, mathematical tools and program paradigms of AI.
CO3:	Apply intelligent agents for Artificial Intelligence programming techniques
CO4:	Apply problem solving through search for AI applications

Unit 1: Introduction to Artificial Intelligence. Natural and artificial intelligence, Structure of Learning, Learning versus Designing, Training versus Testing Description matching and goal reduction, exploiting natural constraints in problem solving, Exploiting alternative paths, Best paths.

Unit 2: Reasoning, Logic and Theorem proving: Deductive and inductive reasoning. Heuristic methods, proof by resolutions and constraint propagation, problem solving paradiagrams.

Unit 3: Knowledge replacement: First order predicates calculus, Skolemlsation, Resolution principle, Unification nementic networks, frame, system value inheritance, introduction to prolog, Introduction to expert systems, application of expert system and various shells.

Unit 4: Application of artificial intelligence methods in various disciplines: database management, computer aided.

Unit 5: Design principles of pattern recognition system, Statistical pattern recognition, Parameter estimation methods-Principle Component Analysis(PCA) and Linear discriminant analysis (LDA),Classification Techniques, Nearest Neighbor(NN) Rule, Bayes Classifier, Support Vector Machine (SVM)

Text Book / References

[1] Russell, Norvig, Artifificial Intelligence: A Modern Approach, Third edition, Prentice Hall,2010
[2] Tsang. Foundations of constraint satisfaction, Academic press, 1993
[3] Gendreau, Michel, and Jean-Yves Potvin, Handbook of metaheuristics, Springer, 2010.

Course Code : **IME-1002(4)**
Course Name : **Machine Learning**

Course Outcomes (COs)	
CO1:	Develop a good understanding of fundamental principles of machine learning
CO2:	Formulation of a Machine Learning problem.
CO3:	Develop a model using supervised/unsupervised machine learning algorithms for classification/prediction/clustering
CO4:	Evaluate performance of various machine learning algorithms on various data sets of a domain.

Unit 1: Introduction to Machine Learning Why Machine learning, Examples of Machine Learning Problems, Structure of Learning, Learning versus Designing, Training versus Testing, Characteristics of Machine learning tasks, Predictive and descriptive tasks, Machine learning Models: Geometric Models, Logical Models, Probabilistic Models. Features: Feature types, Feature Construction and Transformation, Feature Selection.

Unit 2: Classification and Regression Classification: Binary Classification- Assessing Classification performance, Class probability Estimation- Assessing class probability Estimates, Multiclass Classification. Regression: Assessing performance of Regression- Theory of Generalization: Effective number of hypothesis, VC Dimensions, Regularization theory.

Unit 3: Linear Models Least Squares method, Multivariate Linear Regression, Regularized Regression, Using Least Square regression for Classification, Perceptron, Support Vector Machines, Soft Margin SVM, Kernel methods for non-Linearity.

Unit 4: Logic Based and Algebraic Models Distance Based Models: Neighbours and Examples, Nearest Neighbours Classification, Distance based clustering-K means Algorithm, Hierarchical clustering, Rule Based Models: Rule learning for subgroup discovery. Tree Based Models: Decision Trees, Ranking and Probability estimation Trees.

Unit 5: Probabilistic Models Normal Distribution and Its Geometric Interpretations, Naïve Bayes Classifier, Discriminative learning with Maximum likelihood, Probabilistic Models with Hidden variables: Estimation-Maximization, Trends in Machine Learning: Model and Symbols-Bagging and Boosting, Data Streams and Active Learning, Deep Learning, Reinforcement Learning.

Text Book / References

[1] Tom Mitchell, "Machine Learning", McGraw Hill, 1997
[2] E. Alpaydin, "Introduction to Machine Learning", PHI, 2005.
[3] Andrew Ng, Machine learning yearning, https://www.deeplearning.ai/machine-learningyearning/
[4] AurolienGeron, Hands-On Machine Learning with Scikit-Learn and TensorFlow, Shroff/O'Reilly
[5] Andreas Muller and Sarah Guido, Introduction to Machine Learning with Python: A Guidefor Data Scientists, Shroff/O'Reilly.

Course Code : **IME-1003**
Course Name : **Digital Signal Processing**

Course Outcomes (COs)	
CO1:	Illustrate digital signals, systems and their significance
CO2:	Analyze the digital signals using various digital transforms DFT, FFT etc.
CO3:	Design and develop the basic digital system.
CO4:	Interpret the finite word length effects on functioning of digital filters.

Unit 1: Introduction Limitations of analog signal processing, Advantage digital signal processing, discrete time characterization of signals & systems some elementary discrete time sequences and systems, concepts of stability and causality.

Unit 2: Discrete Fourier Transform: DFT and its properties; linear, periodic and circular convolution, linear filtering methods based on DFT, filtering of long data sequences; fast Fourier transform algorithm using decimation in time and decimation in frequency techniques; linear filtering approaches to computation of DFT. Sampling and reconstruction

Unit 3: Transform Analysis of LTI Systems Frequency response of LTI systems, system function for system characterized by linear constant coefficient difference equations. Relationship between magnitude and phase, all pass systems, minimum phase systems. Structure for discrete time systems, Signal flow graph representation, transposed forms, lattice structures.

Unit 4: Filter Design Techniques: Linear phase FIR filters, design of FIR filters impulse invariance, bilinear transformation; Matched Z- transformation, by windowing: Kaiser Window method, optimum approximations of FIR filters, FIR equi-ripple approximation

Unit 5: Finite Precision Effects Fixed point and floating point representations, overview of finite precision numerical effects, effects of coefficient quantization, Effects of round-off noise in digital filters, zero-input limit cycles in fixed point realizations of IIR digital filters. Digital signal processors Architecture and various features of TMS/ADSP, series of digital signal processors; TMS 320CXX.

Textbooks/References

[1] S. Salivahanan, "Digital Signal Processing", McGraw Hill Education (India).
[2] Oppenheim A.V.,"Discrete Time Signal processing", Pearson Education.
[3] Proakis, J.G. & Manolakis, D.G.," Digital Signal Processing: Principles Algorithms and Applications", Prentice Hall of India.
[4] Rabiner, L.R. and Gold B., "Theory and applications of DSP", Prentice Hall of India.
[5] Oppenheim, Alan V. & Willsky, Alan S., "Signals and Systems" , Prentice Hall of India, 2nd Edition

Course Code : **IME-1004(L)**
Course Name : **Digital Signal Processing Lab**

LIST OF EXPERIMENTS

[1] Generation of signals.

[2] Linear convolution and Circular Convolution of two given sequences

[3] To determine z-transform from the given transfer function and its ROC using MATLAB.

[4] Introduction of Filter design and analysis (FDA) tool.

[5] Design and implementation of digital filter for given set of specifications

[6] Design and implementation of FIR filter using window techniques.

[7] Finite word length Effect in Digital filter

Note: 20% experiments other than this list of equal standard relevant to syllabus can also be set.