B. Tech. (ECE) – Curriculum (IIITSUGECE15)

Semester-wise Curriculum

I Semester

Sl. No.	Code	Course Name	L	T	P	C
1	MS1101	Advanced Calculus for Engineers	3	1	0	4
2	PH1101	Contemporary Physics for Engineers	3	1	0	4
3	CY1101	Contemporary Chemistry for Engineers	3	0	0	3
4	CE1101	Introduction to UNIX and C Programming	3	0	0	3
5	HS1101	Communication Skills	3	0	2	4
6	PY1101	Physics and Chemistry Laboratory	0	0	0	2
7	CE1102	UNIX and C Programming Laboratory	0	0	0	2
8	EP1101	Engineering Practices	0	0	0	2
9	NC1101	NSS/NCC/YRC (Non-Credit)	0	0	0	0

Total Credits: 24

II Semester

Sl. No.	Code	Course Name	L	T	P	C
1	MAIR12	Complex Analysis and Transforms	3	1	0	4
2	PHIR12	Solid State Physics	3	0	0	3
3	CMIR11	Civil and Mechanical Engineering	3	0	0	3
4	ECPC21	Digital Logic Design	3	0	0	3
5	ECPC22	Electrical Circuits and Machines	3	0	2	4
6	CSPC22	Object Oriented Programming Technology	2	0	2	3
7	EGIR11	Engineering Graphics	2	0	2	3
8	HSIR21	Environmental Science	3	0	0	3
9	HSIR22	Communication Skills II	0	0	2	1
10	HSIR23	Introduction to Professional Courses (Non-Credit)	0	0	0	0

Total Credits: 27

III Semester

Course Code	Course Type	Course Name	L	T	P	C
MAIR34	GIR	Real Analysis and Partial Differential Equations	3	0	0	3
ECPC31	PC	Signals and Systems	3	1	0	4
ECPC32	PC	Network Analysis and Synthesis	3	0	0	3
ECPC33	PC	Electrodynamics and Electromagnetic Waves	3	1	0	4
ECPC34	PC	Semiconductor Physics and Devices	3	0	0	3
ECPC35	PC	Digital Circuits and Systems	3	0	0	3
ECLR31	ELR	Devices and Networks Laboratory	0	0	3	2
ECLR32	ELR	Digital Electronics Laboratory	0	0	3	2

Total Credits: 24

IV Semester

Course Code	Course Type	Course Name	L	T	P	C
MAIR45	GIR	Probability theory and Random Processes	3	0	0	3
HSIR14	GIR	Professional Ethics	3	0	0	3
ECPC41	PC	Digital Signal Processing	3	1	0	4
ECPC42	PC	Transmission Lines and Waveguides	3	0	0	3
ECPC43	PC	Electronic Circuits	3	0	0	3
ECPC44	PC	Microprocessors and Micro controllers	3	0	0	3
ECLR41	ELR	Electronic Circuits Laboratory	0	0	3	2
ECLR42	ELR	Microprocessor and Microcontroller Laboratory	0	0	3	2

Total Credits: 23

V Semester

Course Code	Course Type	Course Name	L	T	P	C
ECPC51	PC	Statistical Theory of Communication	3	1	0	4
ECPC52	PC	Digital Signal Processors and Applications	3	0	0	3
ECPC53	PC	Analog Communication	3	0	0	3
ECPC54	PC	Analog Integrated Circuits	3	0	0	3
E1	PE – I		3	0	0	3
E2	PE / OE / MI – I		3	0	0	3
ECLR51	ELR	Analog Integrated Circuits Laboratory	0	0	3	2
ECLR52	ELR	Digital Signal Processing and Simulation Laboratory	0	0	3	2

Total Credits: 23

VI Semester

Course Code	Course Type	Course Name	L	T	P	C
ECPC61	PC	Digital Communication	3	0	0	3
ECPC62	PC	Wireless Communication	3	0	0	3
ECPC63	PC	VLSI Systems	3	0	0	3
ECPC64	PC	Antennas and Propagation	3	0	0	3
E3	PE – II		3	0	0	3
E4	PE / OE / MI – II		3	0	0	3
ECLR61	ELR	Communication Engineering Laboratory	0	0	3	2
ECLR62	ELR	VLSI and Embedded System Design Laboratory	0	0	3	2
ECIR16	GIR	Internship/ Industrial Training/ Academic Attachment	0	0	0	2
ECIR19	GIR	Industrial Lecture	0	0	0	1

Total Credits: 25

VII Semester

Course Code	Course Type	Course Name	L	T	P	C
ECPC71	PC	Microwave Components and Circuits	3	0	0	3
HSIR13	GIR	Industrial Economics and Foreign Trade	3	0	0	3
E5	PE –III		3	0	0	3
E6	PE / OE / MI – III		3	0	0	3
E7	PE / OE / MI – IV		3	0	0	3
CSIR18	GIR	Comprehensive Viva-Voce	3	0	0	3

Total Credits: 18

VIII Semester

Course Code	Course Type	Course Name	L	T	P	C
ECPC81	PC	Fiber Optic Communication	3	0	0	3
E8	PE –IV		3	0	0	3
E9	PE / OE / MI – V		3	0	0	3
E10	PE / OE / MI – VI		3	0	0	3
ECIR17	GIR	Project Work	6	0	0	6

Total Credits: 18

Summary

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	24	27	24	23	23	25	18	18	182

List of Electives

V Semester

Programmme Electives – I(1 out of 3)

- Display Systems
- Statistical Signal Processing
- Communication Switching Systems

Programmme/ Open Electives / Minor from other Dept. - I (1 out of 2)

- Computer Architecture and Organization
- Multimedia Communication Technology

VI Semester

Programmme Electives - II (1 out of 3)

- RF MEMS Circuit Design
- Principles of Radar
- Digital Signal Processing for Wireless Communication

Programmme/ Open Electives / Minor from other Dept. – II (1 out of 2)

- ARM System Architecture
- Networks and Protocols

VII Semester

Programmme Electives - III (1 out of 3)

- Cognitive Radio
- Broadband Access Technologies
- Satellite Communication

Programmme/ Open Electives / Minor from other Dept. – III, IV

- Ad hoc Wireless Networks
- Digital Image Processing

VIII Semester

Programmme Electives - IV (1 out of 3)

- Microwave Integrated Circuit Design
- Microwave Electronics
- Electronic Packaging

Programmme/ Open Electives / Minor from other Dept. –V & VI

- Wireless Sensor Networks
- Digital Speech Processing
- Pattern Recognition

Electives for B. Tech. (Honors)*

Course Code	Course Name	L	T	P	C
ECHO11	Advanced Digital Signal Processing	3	0	0	3
ECHO12	Spectral Analysis Of Signals	3	0	0	3
ECHO13	Detection and Estimation	3	0	0	3
ECHO14	Wavelet Signal Processing	3	0	0	3
ECHO15	RF Circuits	3	0	0	3
ECHO16	Numerical Techniques for MIC	3	0	0	3
ECHO17	Applied Photonics	3	0	0	3
ECHO18	Advanced Radiation Systems	3	0	0	3
ECHO19	Bio MEMS	3	0	0	3
ECHO20	Analog IC Design	3	0	0	3
ECHO21	VLSI System Testing	3	0	0	3
ECHO22	Electronic Design Automation Tools	3	0	0	3
ECHO23	Design of ASICs	3	0	0	3
ECHO24	Digital System Design	3	0	0	3
ECHO25	Digital Signal Processing Structures for VLSI	3	0	0	3
ECHO26	Low Power VLSI Circuits	3	0	0	3
ECHO27	VLSI Digital Signal Processing Systems	3	0	0	3
ECHO28	Asynchronous System Design	3	0	0	3
ECHO29	Physical Design Automation	3	0	0	3
ECHO30	Mixed - Signal Circuit Design	3	0	0	3
ECHO31	Digital Signal Processing for Medical Imaging	3	0	0	3

** - Eligibility Criteria: As per the existing institute norms*

Minors Offered

Course Code	Course Title	L	T	P	C
ECMI11	Signals And Systems	3	0	0	3
ECMI12	Network Analysis and Synthesis	3	0	0	3
ECMI13	Electrodynamics and Electromagnetic Waves	3	0	0	3
ECMI14	Semiconductor Physics and Devices	3	0	0	3
ECMI15	Digital Circuits and Systems	3	0	0	3
ECMI16	Digital Signal Processing	3	0	0	3
ECMI17	Analog Communication	3	0	0	3
ECMI18	Digital Communication	3	0	0	3
ECMI19	Wireless Communication	3	0	0	3

FIRST SEMESTER

Course Code	:	**MS1101**
Course Title	:	**Advanced Calculus for Engineers**
Number of Credits	:	**4**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

Differential Calculus: Successive differentiation, Leibnitz theorem, indeterminate form, Limit, continuity and differentiability of functions of several variables, partial derivatives and their geometrical interpretation, differentials, derivatives of composite and implicit functions, derivatives of higher order, Euler's theorem on homogeneous functions, harmonic functions, Taylor's and Maclaurin's series, Taylor's expansion of functions of two variables, maxima and minima of functions of two variables , Lagrange's method of multipliers, Change of variables , Jacobians.

Applications of Differential Calculus: Curvature in Cartesian co-ordinates, Centre and radius of curvature, Circle of curvature, Evolutes, Envelopes, Evolute as envelope of normal, Case studies.

Integral Calculus: Multiple Integrals, Improper Integrals, Beta and Gamma function, Double Integrals, Calculating Double Integrals, Calculating Areas and Volumes by Means of Double Integrals, Double Integral in Polar Coordinates, Changing Variables in a Double Integral, Computing the Area of a Surface, Triple Integrals, Evaluating a Triple Integral, Change of Variables in a Triple Integral, Volume of Solids, Case studies.

Vector Differential Calculus: Vectors in 2D Space and 3D Space, Dot Product, Cross Product, Vector and Scalar Functions and their Fields, Vector Calculus, Derivatives, Curves, Arc Length, Curvature, Torsion, Calculus Review, Functions of Several Variables, Gradient of a Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector, Case studies.

Vector Integral Calculus: Integral Theorems, Line Integrals, Path Independence of Line Integrals, Green's Theorem in the Plane, Surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Divergence Theorem of Gauss, Stokes's Theorem, Verification and applications of theorems, Case studies.

Text Books

1. Kreyszig. E, Advanced Engineering Mathematics, 9^{th} edition, John Wiley Sons, 2006.
2. Grewal.B.S, Higher Engineering Mathematics, 41^{st} edition, Khanna Publications, Delhi, 2011.
3. Greenberg.M.D, Advanced Engineering Mathematics, 2^{nd}Edition, Pearson Education Inc., 2002.

References

1. Apostol.T.M, Calculus Volume I & II, 2^{nd} Edition, John Wiley & Sons, 2005.
2. Glyn James, Advanced Modern Engineering Mathematics, 4^{th} Edition, Pearson Education Limited, 2011.
3. Strauss. M.J, Bradley, G.L. and Smith, K.J. Calculus, 3rd Edition, Prentice Hall, 2002.

Course Code	:	**PH1101**
Course Title	:	**Contemporary Physics for Engineers**
Number of Credits	:	**4**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

Crystal Physics: Crystal directions, Planes and Miller indices, Basic symmetry elements, Translational symmetry elements, Reciprocal lattice, Diamond and HCP crystal structure, Imperfections in crystals, Cryogenics, Methods of liquefaction of gases, Measurement of cryogenic temperatures, Case studies.

Atomic and Nuclear Physics: Atoms, atomic models, hydrogen atom, Molecular bonding, energy levels and spectra of polyatomic molecules, Basic properties of a nucleus, Mass and Atomic Numbers, Isotopes, mass and size of a nucleus, Nuclear force, Nuclear Radii, Nuclear Masses, Binding energy, mass defect, Nuclear Spin and Magnetism and nuclear force, Basic Nuclear reactions, Q-value, Exothermic, Endothermic Nuclear model, Nuclear Reactors, Nuclear Fusion; Thermonuclear Fusion, Case studies.

Overview of Classical Physics and Quantum Physics: Mechanics, Electromagnetism, Thermodynamics, Kinetic theory, Waves and Particles, Conservation laws, Failures of classical physics, Classical relativity, Einstein’s postulates, Doppler Effect, Relativistic energy and momentum, Blackbody radiation, photoelectric effect, Compton scattering, x-rays, Bohr model, Postulates of quantum mechanics, Quantum operators, Schrödinger equation, probabilities, normalization, Schrödinger equation for 1D, 2D and three dimensional particle in a box, tunneling particle in a well and simple harmonic oscillator, Case studies.

Optics, Quantum Optics and Laser: Nature of light, Propagation of Light, Images, Lenses, Optical instruments, Refractive index, Reflection and Refraction, Polarization of light, Interference and Diffraction, Overview of quantum optics, electromagnetic field, states and representations, Basic concepts of lasers, characteristics of laser, Types of lasers: Nd-YAG Laser, He-Ne Laser, Semiconductor diode laser and Quantum cascade Laser, Application of Lasers, Case studies.

Recent Trends in Physics (Qualitative Studies): Nanophysics, Biophysics, Astrophysics and cosmology, Green energy physics, Chaos and Fractals.

Text Books

1. Stephen T. Thornton and Andrew Rex, Modern Physics for Scientists and Engineers, 4th Edition, 2006.
2. Kenneth Krane, Modern Physics, 3rd Edition, Wiley Publishers, 2012.

References

1. Paul A. Tipler and Gene Mosca, Physics for Scientists and Engineers, 5th Edition, 2003.
2. Guozhong Cao, Nanostructures & Nanomaterials: Synthesis, Properties & Applications, World Scientific Publishing Co. Pte. Ltd, Imperial College Press, 2004.
3. J.Peatross and M.Ware, Physics of Light and Optics, 2015 Edition, optics.byu.edu.
4. Q. Ho Kim, N. Kumar, and C. S. Lam, Invitation to Contemporary Physics, 2nd Edition, World Scientific Publishers, 2004.

Course Code	:	**CY1101**
Course Title	:	**Contemporary Chemistry for Engineers**
Number of Credits	:	**3**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

Bonding: Overview of Classical Chemistry(qualitative), Basic concepts, bonding in metals, electron gas theory, physical properties of metals, electrical and thermal conductivity, opaque and lusture, malleability and ductility, Alloy substitutional alloys, interstitial alloys, Coordinate bond, Case studies.

Quantum Mechanics: Introduction to Quantum Mechanics, Wave Motion and Light, Evidence for Energy Quantization in Atoms, Predicting Discrete Energy Level, Atomic Structure, Hydrogen Atom, Shell model of Electron Atoms, Principle and Electron Configurations, Periodic properties and Electronic Structure, Case studies.

Chemical Kinetics and Nuclear Chemistry: Chemical Kinetics, Rates of chemical reactions, Rate Laws, Reaction Mechanisms, Nuclear Chemistry, Nuclear Structure and Decay Processes, Kinetics of Radioactivity, Radiation in Biology and Medicine, Nuclear Fission, Nuclear Fusion and Nucleo Synthesis, Case studies.

Spectroscopic Techniques: Interaction of Electromagnetic radiation with matter, Born–Oppenheimer approximation IR Spectroscopy, Instrumentation and Applications, Unsaturated Ketones, NMR α , αWoodward, Shielding and Deshielding, Chemical shift, Applications, Atomic absorption and Atomic Emission Fundamentals, Case studies.

Water and Environmental Chemistry: Water and its treatment, Sources of water, Impurities in water, Hardness of water and its determination, Scale and Sludge Formation, Composition properties and methods of prevention, Treatment of Water, Environmental Segments, Air Pollution, Pollutants, Photochemical Smog, Biological Oxygen Demand, Chemical Oxygen Demand, Control of Air Pollution, Case studies.

Text Books

1. David W. Oxtoby, H. Pat Gillis, Alan Campion, Principles of Modern Chemistry, 6th Edition, Cengage Brain Publications, ISBN-10: 0534493661 | ISBN-13: 9780534493660, 2011.
2. P. C. Jain and M. Jain, Engineering Chemistry, Dhanpat Rai Publishing Company, New Delhi, 2005.
3. Hari Singh Nalwa, Nanostructured Materials and Nanotechnology, Academic Press, 2002
4. C. N. Banwell and E.M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata Mc Graw-Hill Edition, 1995.

References

1. Vairam S, Kalyani P and Subha Ramesh, Engineering Chemistry, Wiley India Pvt Ltd., New Delhi, 2011.
2. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing Company, 2008.
3. Shashi Chawla, A Reading of Engineering Chemistry, 3rd Edition, Dhanpat Rai and Co., New Delhi, 2007.
4. S. S. Dara, and S. S. Umare, A Text Book of Engineering Chemistry, S. Chand Publishing, 2011.
5. F.W. Billmayer. Textbook of Polymer Science, 3rd Edition, Wiley. N.Y, 1991.
6. A.R. West, Basic Solid State Chemistry, 2nd Edition, John Wiley and Sons, 1999.
7. A. Nabok, Organic and Inorganic Nanostructures, Artech House, 2005.

Course Code	:	**CE1101**
Course Title	:	**Introduction to UNIX and C Programming**
Number of Credits	:	**3**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

Basics of UNIX: Study of Unix OS, Basic Shell Commands, Unix Editor, Frequently used commands and utilities, Files & directories, Input/output redirection, Pipelines and Filters, Concept of Users and Groups, User access privileges, Networking Utilities, Ping, ifconfig, ssh, scp etc.

Structured Programming and Basics of C Language: Introduction to C programming, fundamentals, structure of a C program, compilation and linking processes, Constants, Variables, Data Types, Expressions using operators in C, Managing Input and Output operations, Decision Making and Branching, Looping statements, Solving simple scientific and statistical problems.

Arrays and Strings: Arrays, Initialization, Declaration, One dimensional and Two dimensional arrays, String, String operations, String Arrays, Simple programs, Sorting, Searching, Matrix operations.

Functions, Pointers, Structures and Unions: Definition of function, Declaration of function, Pass by value, Pass by reference, Recursion, Pointers, Definition, Initialization, Pointers arithmetic, Pointers and arrays, Structure definition, Structure declaration, Structure within a structure, Union, Programs using structures and unions.

Advanced Features of C: File processing in C, Files and Streams, Sequential & Random-Access Files, Low-Level Programming, Storage classes, Pre-processor directives, Dynamic Memory Allocation, Command Line Arguments.

Text Books

1. Peter Dyson, Stan Kelley Bootle, John Heliborn, "UNIX Complete", SYBEX Inc, 1999.
2. Deitel P J, Deitel H M, "C : How To Program", Prentice Hall, Seventh Edition, 2012.

References

1. John Muster & Associates, "UNIX Made Easy", 2nd Edition, McGraw-Hill, 1996.
2. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006.
3. Byron S Gottfried, “Programming with C”, Schaum's Outlines, Third Edition, Tata McGraw-Hill, 2011.
4. Yashavant P. Kanetkar. “Let Us C”, BPB Publications, 2011.
5. Stephen G. Kochan, “Programming in C”, 3rd edition, Pearson Education, 2004.

Course Code	:	**HS1101**
Course Title	:	**Communication Skills - I**
Number of Credits	:	**4**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

Listening Skills: Types of Listening, Tips for Effective Listening, Academic Listening, Listening to Talks and Presentations, Listening to Announcements of: railway, bus stations, airport, stadium announcement etc., Listening to Radio and Television.

Speaking Skills: Phonetics, Intonation, Ear training, Correct Pronunciation, Sound recognition exercises, Common errors in English, Conversations: Face to Face Conversation, Telephone conversation, Role play, Making Presentations.

Reading Skills: Understanding notices, messages, timetables, adverts, graphs etc., Reading passages, short reading passage, long reading passage, Skimming, Scanning, Note-making, Error Correction.

Writing Skills: Standard Business letter, Report writing, Email drafting and Etiquettes, Preparing Agenda and writing minutes for meetings, Making notes on Business conversations, Effective use of SMS, Case writing and Documentation.

Assessment

1) Assignments
2) Class room interaction
3) Activities
4) Presentation
5) Quiz
6) Extensive Reading

Text Books:

1. Aruna Koneru, Professional Communication, McGraw Hill, 2008.
2. John Seely, The Oxford Guide to Writing and Speaking, Oxford University Press, 2004.
3. Meenakshi Raman and Sangeeta Sharma, Technical Communication Principles and Practices, Oxford University Press, 3rd Edition, 2015.
4. Frederick T.Wood, A Remedial English Grammar for Foreign Students, Macmillan Education, 1965.

Course Code	:	**PY1101**
Course Title	:	**Physics and Chemistry Laboratory**
Number of Credits	:	**2**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

Physics Laboratory - List of Experiments

1. Interference of light: Newton Rings or Air Wedge
2. Torsional Pendulum: Rigidity Modules or Moment of Inertia
3. Lees' Disc: Thermal conductivity of bad conductor
4. Optical Fibre: Determination of refractive index & Losses
5. Acoustic Grating: Using ultra sonic interoferometer – Determination of No. of lines and wave length measurement
6. Post Office Box: Measurement of unknown resistance
7. Spectrometer: Prism – Determination of refraction index, spectrometer - grating

Chemistry Laboratory - List of Experiments

1. Acid-Base titration: Titration of weak acid with a strong base
2. Determination of the Concentration of Hydrochloric Acid present in a given Solution
3. Estimation of hardness of Water by EDTA
4. Estimation of Chloride in Water sample (Argentometric)
5. Estimation of alkalinity of Water sample
6. Determine the total alkalinity in a sample of tap water by using a standard acid
7. Potentiometry: Redox Titration

Course Code	:	**CE1102**
Course Title	:	**UNIX and C Programming Laboratory**
Number of Credits	:	**2**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

List of Experiments

1. Study and execute the following:
    a) General purpose commands
    b) Files and Directory commands
    c) Input/Output Redirection commands
    d) Pipelines and Filter commands
    e) Concept of Users groups and User access privileges
    f) Networking Utilities
2. Write simple C programs for Arithmetic Calculator, Conversion Programs, Print date, Get IP address, Shutdown computer, Swapping two numbers.
3. Write C Programs for Branching and Looping to Check the given number is : Odd or Even, Leap year or not, Factorial value, Prime or not, Palindrome or not, Armstrong or not, Sum of the series- Print Floyd's and Pascal's triangle etc.,
4. Write a C program for the basic operations of Matrices using arrays.
5. Write a C program for sorting numbers using arrays and pointers (Various Sorting methods).
6. Write a C program for Linear search and Binary search using arrays and pointers.
7. Write a C program for finding maximum and minimum element in an array.
8. Write a C program to exploit all storage classes.
9. Write a C program for Call by Value using functions.
10. Write a C program to demonstrate Call by Reference.
11. Write a C program to demonstrate Recursion.
12. Write a C program for String Manipulations (String length, Compare strings, Copy string, Concatenate strings, Reverse string to find palindrome).
13. Write C programs to implement Student database and Employee database using Structures and Unions.
14. Write a C program to demonstrate dynamic memory allocation.
15. Write a C program to demonstrate command line arguments

Course Code	:	**EP1101**
Course Title	:	**Engineering Practices**
Number of Credits	:	**2**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

List of Experiments

I. Wiring

1. Study of tools and accessories
2. Tube light and fan connection
3. Staircase wiring
4. Living room wiring
5. Godown wiring
6. Lamp controlled from three different places wiring

II. Fitting

1. Study of tools and machineries
2. Symmetric fitting
3. Acute angle fitting

III. Welding

1. Study of arc and gas welding equipment and tools
2. Simple lap welding
3. Single V butt welding

IV. Carpentry

1. Study of tools and machineries
2. Half lap joint
3. Corner mortise joint

SECOND SEMESTER

Course Code	:	**MAIR12**
Course Title	:	**Complex Analysis and Transforms**
Number of Credits	:	**4**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

Analytic Function: Review of complex numbers - Functions of a complex variable - Limit and continuity - Derivative - CR-equations - Analytic functions- Mapping by Elementary functions- Linear fractional transformations (Bilinear transformation)-Conformal Transformation.

Complex Analysis: Contour integrals - Cauchy Integral Formula -Taylor's and Laurent's expansions - Zeros and singularities of an analytic function - Residues - Residue theorem - Evaluation of definite integrals.

Laplace Transforms: Laplace Transform - Properties of Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Multiplication by t^n-Transforms of unit step function and impulse functions – Transform of periodic functions - Inverse Laplace transform -Statement of Convolution theorem – Initial and final value theorems – Solution of linear ordinary differential equations of second order with constant coefficients using Laplace transformation techniques.

Fourier Transforms: Introduction - Fourier integrals - Fourier sine and cosine integrals-complex forms of Fourier integral - Fourier transform - Finite Fourier sine and cosine transforms - Properties of Fourier transform-convolution Theorem for Fourier transforms- Parseval's identity for Fourier-Transforms -Fourier transforms of the derivatives of a function.

Z-Transforms: Introduction -some standard Z-transforms - Linearity property- Damping Rule- Shifting u_n to the right and left - Multiplication by n - Two Basic Theorems -Some useful Z-transforms - Some Useful inverse Z-transforms-convolution theorems-convergence of Z-transforms- Evaluation of inverse Z-Transform -Application of Difference equations.

Text Books

1. Grewal B.S., Higher Engineering Mathematics, 42nd Edition, Khanna Publications, Delhi, 2011.
2. R.V.Churchill and J.W.Brown, Complex variables and applications, 7th Edition, McGraw-Hill, 2003.

References

1. Kreyszig. E, Advanced Engineering Mathematics, 10th Edition, John Wiley Sons, 2006.
2. Greenberg, M.D. Advanced Engineering Mathematics, 2nd Edition, Pearson Education, 2002.
3. Hsiung, C.Y. and Mao, G. Y. 'Linear Algebra', World Scientific Pub Co Inc., 1999.
4. J. M. Howie, Complex analysis, Springer-Verlag (2004).
5. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa Pub. House, 2008.
6. Strang's MIT Linear Algebra Course. Videos of lectures and more: http://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010.
7. The Linear Algebra toolkit: http://www.math.odu.edu/_bogacki/lat.

Course Code	:	**PHIR12**
Course Title	:	**Solid state physics**
Number of Credits	:	**3**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

Overview of Band Theory of Solids and Thermal Properties of Solids: Bloch theorem – Kronig Penney model- Energy versus wave vector relationship – number of wave functions in a band – Velocity and effective mass of electron – Forces between atoms-Cohesion of atoms and cohesive energy-Calculation of cohesive energy **-** Lenard Jones Potential–Einstein's theory of specific heat capacity of solids **-** Debye's theory of specific heat capacity of solids.

Magnetism in Solids: Diamagnetism-Langevin's Theory- Paramagnetism - Weiss Theory of Paramagnetism- Determination of susceptibilities of para and diamagnetic materials – Guoy's method and Quincke's method-Ferromagnetism-Domain Theory of Ferromagnetism -Hysteresis – types of magnetic materials soft and hard materials-Antiferromagnetism - Ferrites-Structure of ferrites – Applications.

Superconducting Materials: Superconductivity- Types of superconductors -Type I and Type II superconductors-BCS Theory - Meissner Effect - Isotopic effect - Magnetic field effect- Critical currents - Josephson device–High T_c superconductors – Thermal Properties - London equations Electrodynamics –Thermodynamics of superconductors – Quantum tunnelling - Applications of Superconductors.

Dielectrics, Ferroelectrics and Piezoelectrics: Microscopic concept of Polarisation— Langevin's Theory of Polarisation in polar dielectrics- Internal field – Claussius - Mosotti equation - Debye's equation- Lorentz-Lorentz formula –Static dielectric constants of solids and liquids - Complex dielectric constant and dielectric loss-dielectric breakdown- Absorption of energy and dielectric loss-Effects of dielectrics-Ferroelectricity-Piezoelectricity.

Solid State Devices: Semiconductors – Intrinsic semiconductors – electrons and holes – Fermi level – Temperature dependence of electron and hole concentrations – Doping impurity states n and p type semiconductors – conductivity- mobility – Hall effect – Hall coefficient. Semiconductor devices: p – n junction- majority and minority carriers –tunnelling diode, light emitting diode.

Text Books

1. Charles Kittel, Introduction to Solid State Physics, Wiley India, 2008.
2. R.K. Puri and V.K. Babbar, Solid State Physics and Electronics, S. Chand & Company Limited, 2004.
3. S. O. Pillai, Solid State Physics, 6^{th} edition, New Age International, 2006.
4. Neeraj Mehta, Applied Physics for Engineers, Prentice-Hall of India, 2011.

References

1. R. Murugesan and Er. Kiruthiga Sivaprasath, Modern Physics, S. Chand & Company Pvt. Limited, 2010.
2. Dr. B. S. Saxena, R.C.Gupta and P.N. Saxena, Fundamentals of Solid State Physics, Pragati Prakashan Publisher, Meerut, 2010.
3. R. K. Gaur and S.L Gupta, Engineering Physics, Dhanpat Rai Publications (P) Ltd, 2013.
4. M. N. Avadhanulu and P. G. Kshirsagar, A Text Book of Engineering Physics, S. Chand and Company, New Delhi, 1992.
5. B.L. Thereja, Basic Electronics- Solid State Physics, S. Chand & Co. Ltd., Ram Nagar, New Delhi, Multicoloured Illustrative Edition, 2007.

Course Code	:	**CMIR11**
Course Title	:	**Civil and Mechanical Engineering**
Number of Credits	:	**3**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

Properties and Uses of Construction Materials: Stones, Sand, bricks, cement, concrete and steel. Buildings: Site selection - Component of building - Foundation- Shallow and deep foundations - Brick and stone masonry, Slab, Flooring, Door and windows and Painting.

Modern Methods and Material Properties: Fundamentals-Classification - Chain Survey - Ranging - Compass Survey - Survey equipment- GPS- Total Station- Green Building-Definition- Principles of green Building - Material Properties - Stress – strain – types – Hook's law – three moduli of elasticity – Poisson's ratio – relationship – factor of safety

Mechatronics: Definition of Mechatronics - Mechatronics in Manufacturing - Review of fundamentals of electronics - Data conversion devices – sensors – microsensors – transducers - signal processing devices – relays - contactors - timers -Microprocessors – controllers - PLCs - Automation - CNC- CIM - FMS.

Thermal Science: Introduction to Thermodynamics - Types of Systems - Thermodynamic Equilibrium – Properties – State - Process and Cycle - Zeroth Law - Energy Interactions - Heat and Work - First and Second Laws of Thermodynamics -Entropy -Basics of heat Transfer- Electronics Cooling Need and applications

Modern Automobiles and Refrigeration Systems: IC Engines: 2 - Stroke and 4 - Stroke Engines- S.I. Engine and C.I. Engine- Differences - Hybrid Vehicles - Battery operated vehicles- Automotive Electronics- Newer Refrigeration systems- Thermoelectric refrigeration- solar refrigeration.

Text Books

1. Bhavikatti S.S, Basic Civil Engineering, New Age International Private Limited Publishers, 2010.
2. Punmia B.C, Ashok Kumar Jain, Arun Kumar Jain, Surveying Vol-I, Laxmi Publications (P) Ltd , 2005.
3. M. L. Mathur, F. S. Mehta and R. P. Tiwari, Elements of Mechanical Engineering , Jain Brothers, New Delhi, Reprint 2012.

References

1. Prof. Dr. Michael Bauer, Peter Mösle and Dr. Michael Schwarz ,Green Building Guidebook for Sustainable Architecture, Springer, 2010.
2. Mili Majumdar, Energy-efficient buildings in India, Tata Energy Research Institute. 2002.
3. TERI, Sustainable Building Design Manual- Volume I & II, Tata Energy Research Institute.

4. G.J.Vanwylen and R.E.Sonntag, Fundamentals of Classical Thermodynamics, Wiley Eastern, New Delhi, 2008.
5. Yonus A Cengel and Michale A Boles, Thermodynamics: An Engineering Approach, McGraw Hill, 2002.
6. Yunus A Cengel, Heat Transfer: An Practical Approach, Tata McGraw Hill Higher education Publishers, 2003.
7. Hajra Choudhary.S.K, and HajraChoudhary.A.K, Elements of Workshop Technology Vols. I & II, Indian Book Distributing Company Calcutta, 2007.
8. Bolton.W, Mechatronics, 2nd Edition, Pearson education, 2003.
9. Smaili.A and Mrad.F , Mechatronics integrated technologies for intelligent machines, Oxford University Press, 2008.

Course Code	:	**ECPC21**
Course Title	:	**Digital Logic Design**
Number of Credits	:	**3**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**PC**

Boolean Algebra and Logic Gates: Review of Number Systems – Arithmetic Operations – Binary Codes and Conversions– Boolean Algebra and Theorems – Boolean Functions – Simplification of Boolean Functions using Karnaugh Map, Quine-McCluskey Method – SOP and POS expressions - AND, OR, NAND, NOR, XOR and XNOR Logic Gates Implementations and Gate Level Minimizations.

Combinational Logic: Combinational Circuits – Analysis and Design Procedures – Circuits for Arithmetic Operations, Code Conversion – MSI Components: Adders, Subtractors, Comparators, Encoders, Decoders, Multiplexers and Demultiplexers – Introduction to HDL – HDL Models of Combinational Circuits – Analysis and Synthesis of Combinational Circuits – Applications – Case Studies.

Synchronous Sequential Logic: Sequential Circuits – Latches and Flip Flops – Analysis and Design Procedures – State Machine Design -State Reduction and State Assignment – Shift Registers – Counters – VHDL for Sequential Logic Circuits – Applications – Case Studies.

Asynchronous Sequential Logic: Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables – Race-free State Assignment – Hazards – Asynchronous Design Problems – Analysis and Synthesis of Sequential Circuits – Applications – Case Studies.

Memory And Programmable Logic: RAM and ROM – Memory Decoding – Error Detection and Correction – Programmable Logic Array – Programmable Array Logic – Sequential Programmable Devices – Complex Programmable Logic Devices – Sequential Circuits with Programmable Logic Devices – Applications – Case Studies.

Text Book

1. M. Morris Mano and Michael D. Ciletti, Digital Design with An Introduction to the Verilog HDL, 5th Edition, Pearson Education, 2013.

References

1. John F. Wakerly, Digital Design Principles and Practices, 4th Edition, Pearson Education, 2006.
2. Charles H. Roth and Larry L.Kinney, Fundamentals of Logic Design, 6th Edition, Cengage Learning, 2014.
3. Donald D. Givone, Digital Principles and Design, Tata MCGraw Hill, 2003.
4. G.K. Kharate, Digital Electronics, Oxford University Press, 2010.
5. Parag K. Lala, Principles of Modern Digital Design, Wiley Publishers, 2007.
6. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with VHDL Design, 3rd Edition, McGraw Hill Education, 2013.
7. Donald P. Leach, Albert Paul Malvino and Goutam Saha, Digital Principles and Applications, 6th Edition, Tata McGraw Hill, 2008.

Course Code	:	**ECPC22**
Course Title	:	**Electrical Circuits and Machines**
Number of Credits	:	**4**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**PC**

DC Circuit Analysis: Basic Components of Electric Circuits, Charge, Current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchoff‘s Current Law, Kirchoff‘s voltage law, The single Node – Pair Circuit, Series and Parallel Connected Independent Sources, Resistors in Series and Parallel, Voltage and Current Division, Nodal analysis, Mesh analysis.

Network Theorem and Duality: Useful Circuit Analysis Techniques - Linearity and Superposition, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Delta-Wye Conversion - Duals, Dual circuits.

Sinusoidal Steady State Analysis: Sinusoidal Steady – State analysis , Characteristics of Sinusoids, The Complex Forcing Function, The Phasor, Phasor relationship for R, L, and C, Impedance and Admittance, Nodal and Mesh Analysis, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, Apparent Power and Power Factor, Complex Power, RLC Circuits, Frequency Response, Parallel Resonance, Series Resonance, Quality Factor.

DC Machines: Construction of DC Machines – Theory of operation of DC generators – Characteristics of DC generators- Operating principle of DC motors – Types of DC motors and their characteristics– Speed control of DC motors- Applications.

Induction Machines and Synchronous Machines: Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit –Construction of single-phase induction motors – Types of single phase induction motors– Double revolving field theory – starting methods - Principles of alternator – Construction details – Types – Equation of induced EMF – Voltage regulation. Methods of starting of synchronous motors – Torque equation – V curves – Synchronous motors.

Text Books

1. Theraja.A.K and Theraja.B.L, A Textbook of Electrical Technology Vol-1&2, S. Chand Publishing, 2007.
2. Del Toro, Electrical Engineering Fundamentals, Pearson Education, New Delhi, 2007.

References

1. William H.Kayt, Jr.Jack E. Kemmerly, Steven M.Durbin, Engineering Circuit Analysis, 6th Edition, Tata McGraw-Hill Edition, 2006.]
2. David A.Bell, Electric Circuits, PHI, 2006.
3. I.J Nagarath and Kothari DP, Electrical Machines,Tata McGraw Hill ,1997.
4. John Bird, Electrical Circuit Theory and Technology, Elsevier, 1st Indian Edition, 2006.
5. David A. Bell, Electronic Instrumentation and Measurement, 2nd Edition, Prentice Hall of India, 2007.
6. Albert D.Helfrick and William D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall of India, 2007.

List of Experiments:

1. Periodic Waveforms, Average and RMS Values
2. Periodic Waveforms and Harmonics
3. Verification of Ohm's law, Kirchoff's Law
4. Single -Phase R, L & C series & Parallel Circuits A-C Circuits
5. DC Circuits (Equivalent Resistance and Series / Parallel Resistance Circuits)
2. Nodal and Mesh Analysis
3. Verification of principle of superposition with DC and AC sources
4. Verification of Thevenin, Norton and Maximum power transfer theorems in AC circuits
5. Voltage generation characteristics of a DC Generator
6. Speed-load control characteristics of a DC Motor
7. Performance of single phase Induction Motor
8. Performance Characteristics of 3-Phase Induction Motor
9. Characteristics of Synchronous Motors

Course Code	:	**CSPC22**
Course Title	:	**Object Oriented Programming Technology**
Number of Credits	:	**3**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

Introduction: Object oriented programming concepts – Objects – Classes – Abstraction and encapsulation – inheritance – Abstract classes – Polymorphism– Function overloading , Operator overloading – Friend functions – Overloading through friend functions - Constant and volatile functions.

Constructors and Destructors: Constructors – Default constructor – Parameterized constructors – Constructor with dynamic allocation – Copy constructor – Destructors– Type conversion – Explicit constructor.

Templates and Exceptions: Function and Class templates - Exception handling.

Inheritance and RTTI: Inheritance - virtual base class – abstract class – Runtime polymorphism – virtual functions – pure virtual functions – RTTI – Dynamic casting – RTTI and templates – cross casting – down casting.

Streams, I/O and Files: Streams and Formatted I/O – I/O manipulators - File handling – ANSI String Objects –Standard Template Library (STL).

Text Books

1. Herbert Schildt, C++ Complete Reference, 4th Edition, McGraw Hill, 2002.
2. HM Deitel and PJ Deitel, C++ How to Program, 7th Edition, Prentice Hall, 2010.

References

1. Ira Pohl, Object Oriented Programming using C++, 2nd Edition, Pearson Education, 2004.
2. S. B. Lippman, Josee Lajoie, Barbara E. Moo, C++ Primer, 4th Edition, Pearson Education, 2005.
3. B. Stroustrup, The C++ Programming Language, 3rd edition, Pearson Education, 2004.
4. B. Trivedi, Programming with ANSI C++, Oxford University Press, 2007.
5. C++ Language Tutorial: http://www.cplusplus.com/doc/tutorial.
6. Wikiversity: Introduction to C++ : https://en.wikiversity.org/wiki/C%2B%2B/Introduction
7. Learn about C++ Programming: http://cplus.about.com/od/learning1.
8. STL Programs Web Link: http://www.tenouk.com/cpluscodesnippet/cplusstandardtemplatelibrarystlsindex.html

List of Experiments

1.
   a. Develop a C++ program using classes and member functions to accept a paragraph, print each word in the paragraph with the number of vowels in each word.
   b. A company produces pens. Three salesmen of the company are selling the pens in four different districts. Develop a C++ program using classes and member functions to read the quantity sold by each salesman in different districts and display the quantity sold by each sales man with district and the total quantity sold.
   c. Develop a C++ program using classes and member functions to perform the arithmetic operations on matrices.
2. Design C++ classes with static members, methods with default arguments, friend functions. (For example, design matrix and vector classes with static allocation, and a friend function to do matrix-vector multiplication)
3. Implement complex number class with necessary operator overloading and type conversions such as integer to complex, double to complex, complex to double etc.
4. Write a C++ program to perform the string concatenation using dynamic memory allocation.
5. Implement Matrix class with dynamic memory allocation and necessary methods. Give proper constructor, destructor, copy constructor, and overloading of Assignment operator overloads the new and deletes operators to provide custom dynamic allocation of memory.
6. Develop templates of standard sorting algorithms such as bubble sort, insertion sort.
7. Exception handling - Divide by Zero, arrays out of bounds, memory exhaustion exception
   a. Insertion and selection sort on (i) integer array (ii) strings
   b. Linear Search and Binary search over (i) integer array (ii) strings
8.
   a. Define Point class and an Arc class. Define a Graph class which represents graph as a collection of Point objects and Arc objects. Write a method to find a minimum cost spanning tree in a graph.
   b. Write a C++ program with two classes named as “one”, “two” to find the area of square and rectangle respectively, and inherit these values to another class named as “cuboid” with its own property “height” to find the area of the cuboid.
9. Develop with suitable hierarchy, classes for Point, Shape, Rectangle, Square, Circle, Ellipse, Triangle, Polygon, etc. Design a simple test application to demonstrate dynamic polymorphism and RTTI.
10. 10.Write a C++ program that randomly generates complex numbers (use previously designed Complex class) and writes them two per line in a file along with an operator (+, -, *, or /). The numbers are written to file in the format (a + ib). Write another program to read one line at a time from this file, perform the corresponding operation on the two complex numbers read, and write the result to another file (one per line).
11.
   a. Develop a simple C++ vector container program.
   b. Implement C++ STL vector using various operators code.
   c. Implement C++ STL vector using constructors.

Course Code	:	**MEIR11**
Course Title	:	**Engineering Graphics**
Number of Credits	:	**3**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

Engineering Graphics and Engineering Curves : Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Plane scales, Diagonal scales,–Lettering and dimensioning Engineering Curves - Basic Geometrical constructions, Curves used in engineering practices - Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – Drawing of tangents and normal to the above curves – Construction of Diagonal and Vernier scales – Representation of Three Dimensional objects – Layout of views.

Projection of Points, Lines and Plane Surfaces: First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

Projection of Solids and Section of Solids: Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method - Section of solids - True shape of section.

Development of Surfaces: Development of prisms, pyramids and cylindrical & conical surfaces. Development of lateral surfaces of solids with cylindrical cut outs, perpendicular to the axis.- Intresection of solids- prism, cylinder and cone - Axes perpendicular and offset - Axes inclined and intersecting - Axes inclined and offset. Free Hand Sketching - Orthographic projection of simple solids- Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

Isometric and Perspective Projections: Principles of isometric projection – isometric scale – Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- Perspective projection of prisms, pyramids and cylinders by visual ray method.

Text Books

1. Bhatt N.D, Engineering Drawing, Charotar Publishing house (P) Ltd, India, 2012.
2. Vargheese P.I, Engineering Graphics, 52nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2013.

References

1. Basant Agarwal and Agarwal C.M, Engineering Drawing, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. Gopalakrishna K.R, Engineering Drawing -Vol I&II combined, Subhas Stores, Bangalore, 2007.
3. Shah M.B. and Rana B.C, “Engineering Drawing”, Pearson, 2nd Edition, 2009.

4. Venugopal. K, Prabhu Raja.V, Engineering Graphics, New Age International(P) Limited, 2008.
5. Jolhe.D. A, Engineering Drawing, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
6. Natarajan.K. V, A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2006.
7. Bhattacharyya B. and Bera S.C, I.K. International Publishing House, 2009.
8. Trymbaka Murthy, S., Computer Aided Engineering Drawing, Pub.: I.K. International Publishing House, 2009.

Course Code	:	**HSIR21**
Course Title	:	**Environmental Science**
Number of Credits	:	**3**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

Environment, Ecosystems and Biodiversity: The multidisciplinary nature of environmental studies, definition, scope and importance -need for public awareness- concept of an ecosystem - structure and function of an ecosystem - energy flow in the ecosystem - ecological succession - food chains, food webs and ecological pyramids - introduction, types, characteristic features, structure and function of the following ecosystem: (a) Forest ecosystem. (b) Grassland ecosystem. (c) Desert ecosystem. (d) Aquatic ecosystems - introduction to biodiversity – definition: genetic, species and ecosystem diversity - value of biodiversity- biodiversity at global, national and local levels - hot-spots of biodiversity. Environmental hydrology and hydraulic principles. Field study of local area to document environmental assets-river/ forest/ grassland/ hill/mountain. Field study of common plants, insects, birds. Field study of simple ecosystems-pond, river, hill slopes, etc.

Environment Pollution and Pollution Abatement: Types of pollution -definition and consequences - air pollution, water pollution , soil pollution , marine pollution, noise pollution, thermal pollution, nuclear hazards - adsorption – types – adsorption of solutes from solutions – role of adsorbents – activated carbon in pollution abatement of air and waste water - Advanced oxidation process (AOPs) to remove organic pollutants in waste water-principles and advantages - solid and hazardous waste management: causes, effects and control measures of municipal solid wastes - role of an individual in prevention of pollution. Recent trends in environmental science and pollution control. Role of Information and Communications Technology (ICT) for monitoring and controlling of environmental pollution at global, national and local levels. Field study of local polluted site-urban/rural/industrial/agricultural and preparation of report

Green Chemistry and Engineering: Principles of Green Chemistry and green engineering-Green Chemistry Methodologies- new methods for organic synthesis and applications - Quantitative/Optimization - Based Frameworks for the Design of Green Chemical Synthesis Pathways.Green Chemistry pollution prevention in material selection for unit operations. Recent trends in Green chemistry.Case studies of the Green Chemistry Methodologies used in academic institutes and industry.

Principles of Sampling and Analysis of Pollutants: Purpose of sampling, different types of samples - water, waste water, soil and air - collection methods - preserving samples - gaseous pollutant monitoring - analytical methods like spectroscopic and chromatographic techniques used for analysis of samples. Case studies of analysis of pollutants by government and private organization. Visit to an analytical lab and or air pollution treatment facility.

Human population and the Environment: Population growth, variation among nations-population explosion – Family Welfare programme - environment and human health - Human Rights - Value Education- HIV/ AIDS - woman and child welfare - role of Information Technology in environment and human health –ICT-applications of IT in global environment-Case studies of the application of ICT in hospitals in India and abroad.

Text Books

1. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill, New Delhi, 2006.
2. Erach Bharucha, Environmental Studies for Undergraduate Courses, UGC, New Delhi and Bharati Vidyapeeth Institute of Environmental and Research, Pune, 2004.

References

1. Rajagopalan. R, Environmental Studies-From Crises to Cure, Oxford University Press, 2011.
2. M. L. Davis and S. J. Masen, Principles of Environmental Engineering and Science, McGraw Hill International Edition, 2004.
3. Bharucha, Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad, India, 2001.
4. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., Environmental Encyclopaedia, Jaico Pub. House, Mumbai, 2001.
5. De A.K., Environmental Chemistry, Wiley Eastern Ltd. , New Delhi, 1994.
6. Rao M.N. & Dutta, A.K., Waste Water Treatment. Oxford & IBH Publ. Co. Pvt. Ltd., 1987.
7. Sharma, B.K., 2001, Environmental Chemistry, Goel Publ. House, Meerut.
8. Allen. D.T, Shonnard, D.R, Green Engineering: Environmentally Conscious Design of Chemical Processes. Prentice Hall PTR, 2002.
9. Mukesh Doble and Anil Kumar Kruthiventi, Green Chemistry and Engineering, Elsevier, Burlington, USA, 2007.
10. RL. Recsok and LD Shields, Modern Methods of Chemical Analysis, John Wiley & sons, Inc, 1990.
11. G.W Ewing, Instrumental Methods of Chemical Analysis, McGraw Hill Book Company, Inc.2, 2001.

Field Work:

(a) Visit to a local area to document environmental assets – river/ forest/ grassland/ hill/ mountain.
(b) Visit to a local polluted site-Urban/ Rural/ Industrial/ Agricultural.
(c) Study of common plants, insects, birds.
(d) Study of simple ecosystems – pond, river, hill slopes, etc.

Course Code	:	**HSIR22**
Course Title	:	**Communication Skills II**
Number of Credits	:	**1**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

Communication Skills - An Overview: Defining communication - Need for effective communicational skills - Nature of communication in social and professional setups - Process of communication - Communication nuances - Barriers to effective communication - Tips to overcome communication barriers.

Listening Skills: Listening versus hearing - Listening process - General versus Academic listening - Importance of Academic listening -Types of Academic listening (Active listening - Attentive listening - Biased listening - Comprehension listening - Critical listening - Discriminative listening - Informational listening - Selective listening - Therapeutic/ Empathetic listening) - Barriers to effective academic listening (Psychological and Physical) - Techniques and strategies to become an effective academic listener.

Speaking Skills: Importance of effective speaking skills - Principles of effective speaking - General speech versus Academic speech - Types of Speeches (Actuate - Conversational - Informative - Persuasive - Interactive - Partially interactive - non-interactive - Negotiation) - Barriers to effective speaking - Tips to become an effective speaker.

Reading Skills: Definition and benefits of reading - General reading versus Academic reading - Process of reading - Types of Academic reading (Intensive reading - Narrow reading - Informational reading - Critical reading - Analytical reading - Close reading) - Benefits of academic reading - Barriers to academic reading - Tips to become an effective reader.

Writing Skills: Characteristics of a good writer - Introduction to academic writing - General writing versus Academic writing - The writing process - Types of Academic writing (Expository writing - Persuasive Writing - Descriptive writing - Narrative writing - Instruction writing - Writing to compare and contrast - Analytical and critical writing - Definition writing - Summary writing - Developing hints - Business / Project proposal writing) - Barriers to effective academic writing - Tips to improve academic writing.

Text Books

1. Urmila Rai, English language communication skills, Himalaya Publishing House, 2010.
2. S. D. Sharma, A text book of professional communicational skills and ESP for Engineers and Professionals, Sarup & Sons, 2006.

References

1. Alan Barker, Improve your communication skills, Kopgan Page Limited, 2010.
2. Richard Ellis, Communication skills: Stepladders to success for the professional, Intellect, 2009.
3. Steven R. Brydon and Michael D. Scott, Between one and many: The art and science of public speaking, McGraw Hill, 2006.
4. Eric Palmer, Teaching the core skills of listening and speaking, ASCD (Association for Supervision and Curriculum Development), 2014.

Course Code	:	**HSIR23**
Course Title	:	**Introduction to Professional Courses (Non – Credit)**
Number of Credits	:	**0**
Prerequisites (Course code)	:	**NONE**
Course Type	:	**GIR**

The professional courses consist of the guest lectures and special lectures given by various eminent experts from well reputed institutions, industries and R&D laboratories. The potential topics covered are state of the art technologies, recent trends in industry and evolving research arena.

THIRD SEMESTER

Course Code	**:**	**MAIR34**
Course Title	**:**	**Real Analysis and Partial Differential Equations**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**GIR**

Course Learning Objective

- To expose the students to the basics of real analysis and partial differential equations required for their subsequent course work.

Course Content

Properties of real numbers, Numerical sequences. Cauchy sequences. Bolzano-Weierstrass and Heine-Borel properties.

Functions of real variables, Limits, continuity and differentiability, Taylor's formula, Extrema of functions.

Riemann integral, mean value theorems, Differentiation under integral sign, Change-of-variables formula, Sequences and series of functions, Point wise and uniform convergence.

Method of separation of variables-Fourier series solution applications to one dimensional wave equation and one-dimensional heat flow equation.

Laplace and Helmholtz equations, Boundary and initial value problems, Solution by separation of variables and Eigen Function Expansion.

Course outcomes

CO1: Develops an understanding for the construction of proofs and an appreciation for deductive logic.

CO2: Explore the already familiar properties of the derivative and the Riemann Integral, set on a more rigorous and formal footing which is central to avoiding inconsistencies in engineering applications.

CO3: Explore new theoretical dimensions of uniform convergence, completeness and important consequences as interchange of limit operations.

CO4: Develop an intuition for analyzing sets of higher dimension (mostly of the R^n type) space.

CO5: Solve the most common PDEs, recurrent in engineering using standard techniques and understanding of an appreciation for the need of numerical techniques.

Text Books

1. Guenther, R.B. &Lee, J.W., "Partial Differential Equations of Mathematical Physics and Integral Equations", Prentice Hall, 1996.
2. W.Rudin, "Introduction to Principles of Mathematical Analysis", McGraw-Hill International Editions, Third Edition, 1976.

Reference Books

1. Kreyszig.E., "Advanced Engineering Mathematics", John Wiley, 1999.
2. S.C. Malik, Savita Arora, "Mathematical Analysis", New Age International Ltd, 4th Edition, 2012.
3. G.B.Gustafson&C.H. Wilcox, "Advanced Engineering Mathematics", Springer Verlag, 1998.

Course Code	**:**	**ECPC31**
Course Title	**:**	**Signals and Systems**
Number of Credits	**:**	**4**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**PC**

Course Learning Objectives

The aim of the course is for

- Understanding the fundamental characteristics of signals and systems.
- Understanding the concepts of vector space, inner product space and orthogonal series.
- Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
- Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

Course Content

Vector spaces. Inner Product spaces. Schwartzin equality. Hilbertspaces. Orthogonal expansions. Bessel's inequality and Parseval's relations.

Continuous-time signals, classifications. Periodic signals. Fourier series representation, Hilbert transform and its properties.

Laplace transforms. Continuous - time systems: LTI system analysis using Laplace and Fourier transforms.

Sampling and reconstruction of band limited signals. Low pass and band pass sampling theorems. Aliasing. Anti-aliasing filter. Practical Sampling-aperture effect.

Discrete-time signals and systems. Z-transform and its properties. Analysis of LSI systems using Z – transform.

Course outcomes

CO1: apply the knowledge of linear algebra topics like vector space, basis, dimension, inner product, norm and orthogonal basis to signals.
CO2: analyse the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis.
CO3: classify systems based on their properties and determine the response of LSI system using convolution.
CO4: analyze system properties based on impulse response and Fourier analysis.
CO5: apply the Laplace transform and Z- transform for analyze of continuous-time and discrete-time signals and systems.
CO6: understand the process of sampling and the effects of under sampling.

Text Books

1. A.V.Oppenheim, A. Willsky, S. Hamid Nawab, "Signals and Systems (2/e)", Pearson 200.
2. S.Haykin and B.VanVeen "Signals and Systems, Wiley, 1998.
3. M.Mandal and A.Asif, "Continuous and Discrete Time Signals and Systems, Cambridge, 2007.

Reference Books

1. D.C.Lay, “Linear Algebra and its Applications (2/e)”, Pearson, 200.
2. K.Huffman&R.Kunz, “Linear Algebra”, Prentice- Hall, 1971.
3. S.S.Soliman&M.D.Srinath, “Continuous and Discrete Signals and Systems”, Prentice- Hall, 1990.

Course Code	**:**	**ECPC32**
Course Title	**:**	**Network Analysis and Synthesis**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**PC**

Course Learning Objectives

- To make the students capable of analyzing any given electrical network.
- To make the students to learn synthesis of an electrical network for a given impedance/ admittance function.

Course Content

Network concept. Elements and sources. Kirchoff's laws. Tellegen's theorem. Network equilibrium equations. Node and Mesh method. Source superposition. Thevenin's and Norton's theorems. Network graphs.

First and second order networks. State equations. Transient response. Network functions. Determination of the natural frequencies and mode vectors from network functions.

Sinusoidal steady-state analysis. Maximum power-transfer theorem. Resonance. Equivalent and dual networks. Design of equalizers.

Two-port network parameters. Interconnection of two port networks. Barlett's bisection theorem. Image and Iterative parameters. Design of attenuators.

Two-terminal network synthesis. Properties of Hurwitz polynomial and Positive real function. Synthesis of LC, RC and RL Networks, Foster Forms and Cauer Forms.

Course outcomes

CO1: analyze the electric circuit using network theorems

CO2: understand and Obtain Transient & Forced response

CO3: determine Sinusoidal steady state response; understand the real time applications of maximum power transfer theorem and equalizer

CO4: understand the two–port network parameters, are able to find out two-port network parameters & overall response for interconnection of two-port networks.

CO5: synthesize one port network using Foster form, Cauer form.

Text Books

1. Hayt W. H., Kemmerly J. E. and Durbin S. M., "Engineering Circuit Analysis", 6th Ed., Tata
   McGraw-Hill Publishing Company Ltd.,2008.
2. F.F. Kuo, "Network analysis and Synthesis", Wiley International Edition ,2008.

Reference Books

1. Valkenberg V., "Network Analysis", 3rd Ed., Prentice Hall International Edition, 2007.
2. B.S.Nair and S.R.Deepa, "Network analysis and Synthesis", Elsevier,2012.

Course Code	**:**	**ECPC33**
Course Title	**:**	**Electrodynamics and Electromagnetic Waves**
Number of Credits	**:**	**4**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**PC**

Course Learning Objectives

- To expose the students to the rudiments of Electromagnetic theory and wave propagation essential for subsequent courses on microwave engineering, antennas and wireless communication

Course Content

Electrostatics. Coulomb'slaw. Gauss's law and applications. Electric potential. Poisson's and Laplace equations. Method of images. Multipole Expansion.

Electrostatic fields in matter. Dielectrics and electric polarization. Capacitors with dielectric substrates. Linear dielectrics. Force and energy in dielectric systems.

Magnetostatics. Magnetic fields of steady currents. Biot-Savart's and Ampere's laws. Magnetic vector potential. Magnetic properties of matter.

Electrodynamics. Flux rule for motional emf. Faraday's law. Self and mutual inductances. Maxwell'sEquations. Electromagnetic Boundary conditions. Poynting theorem.

Electromagnetic wave propagation. Uniform plane waves. Wave polarization. Waves in matter. Reflection and transmission at boundaries. Propagation in an ionized medium.

Course outcomes

CO1: recognize and classify the basic Electrostatic theorems and laws and to derive them.
CO2: discuss the behavior of Electric fields in matter and Polarization concepts.
CO3: classify the basic Magneto static theorems and laws and infer the magnetic properties of matter.
CO4: summarize the concepts of electrodynamics &to derive and discuss the Maxwell's equations.
CO5: students are expected to be familiar with Electromagnetic wave propagation and wave polarization.

Text Books

1. D.J.Griffiths, "Introduction to Electrodynamics (3/e)", PHI, 2001
2. E.C. Jordan & G. Balmain, "Electromagnetic Waves and Radiating Systems", PHI, 1995.

Reference Books

1. W.H.Hayt, "Engineering Electromagnetics, (7/e)", McGraw Hill, 2006.
2. D.K.Cheng, "Field and Wave Electromagnetics, (2/e)", Addison Wesley, 1999.
3. M.N.O.Sadiku,"Principles of Electromagnetics, (4/e)", Oxford University Press, 2011.
4. N.NarayanaRao, "Elements of Engineering Electromagnetics, (6/e)", Pearson, 2006.
5. R.E.Collin, "Foundations for Microwave Engineering (2/e)", McGraw –Hill, 2002.
6. R.E.Collin, "Antennas and Radiowave Propagation", McGraw-Hill, 1985.

Course Code	**:**	**ECPC34**
Course Title	**:**	**Semiconductor Physics and Devices**
Number of Credits		**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**PC**

Course Learning Objectives

- To make the students understand the fundamentals of electronic devices.
- To train them to apply these devices in mostly used and important applications.

Course Content

Semiconductor materials: crystal growth, film formation, lithography, etching and doping. Formation of energy bands in solids, Concept of hole, Intrinsic and extrinsic semiconductors, conductivity, Equilibrium Carrier concentration, Density of states and Fermi level, Carrier transport – Drift and Diffusion, continuity equation, Hall effect and its applications.

P-N junction diodes, Energy band diagram, biasing, V-I characteristics, capacitances. Diode models, Break down Mechanisms, Rectifiers, Limiting and Clamping Circuits, types of diodes.

BJT Physics and Characteristics modes of operation, Ebers-Moll Model, BJT as a switch and Amplifier, breakdown mechanisms, Photo devices.

MOSFET: Ideal I-V characteristics, non-ideal I-V effects, MOS Capacitor, MOSFET as switch, CMOS Logic gate Circuits, Bi-CMOS circuits, CCDs.

Power devices, operation and characteristics. Thyristor family. Power diodes. Power transistors. Display devices, Operation of LCDs, Plasma, LED and HDTV

Course outcomes

CO1: Apply the knowledge of basic semiconductor material physics and understand fabrication processes.
CO2: Analyze the characteristics of various electronic devices like diode, transistor etc.,
CO3: Classify and analyze the various circuit configurations of Transistor and MOSFETs.
CO4: Illustrate the qualitative knowledge of Power electronic Devices.
CO5: Become Aware of the latest technological changes in Display Devices.

Text Books

1. S.M.Sze, Semiconductors Devices, Physics and Technology, (2/e), Wiley, 2002
2. A.S.Sedra & K.C.Smith, Microelectronic Circuits (5/e), Oxford, 2004
3. L.Macdonald &A.C.Lowe, Display Systems, Wiley, 2003

Reference Books

1. Robert Pierret, "Semiconductor Device Fundamentals," Pearson Education, 2006
2. J.Millman and C.C.Halkias : Electronic devices and Circuits, McGraw Hill, 1976.
3. B.G.Streetman : Solid state devices, (4/e), PHI, 1995.
4. N.H.E.Weste, D. Harris, "CMOS VLSI Design (3/e)", Pearson, 2005.

Course Code	**:**	**ECPC35**
Course Title	**:**	**Digital Circuits and Systems**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**PC**

Course Learning Objectives

- To introduce the theoretical and circuit aspects of digital electronics, which is the back bone for the basics of the hardware aspect of digital computers?

Course Content

Review of number systems-representation-conversions, error detection and error correction. Review of Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms-minterm and maxterm, Simplification of Boolean expressions-Karnaugh map, completely and incompletely specified functions, Implementation of Boolean expressions using universal gates.

Combinational logic circuits- adders, subtractors, BCD adder, ripple carry look ahead adders, parity generator, decoders, encoders, multiplexers, demultiplexers, Realization of Boolean expressions- using decoders-using multiplexers. Memories – ROM- organization, expansion. PROMs. Types of RAMs – Basic structure, organization, Static and dynamic RAMs, PLDs, PLAs.

Sequential circuits – latches, flip flops, edge triggering, asynchronous inputs. Shift registers, Universal shift register, applications. Binary counters – Synchronous and asynchronous up/down counters, mod-N counter, Counters for random sequence.

Synchronous circuit analysis and design: structure and operation, analysis-transition equations, state tables and state diagrams, Modelling- Moore machine and Mealy machine- serial binary adder, sequence recogniser, state table reduction, state assignment. Hazard; Overview and comparison of logic families.

Introduction to Verilog HDL, Structural, Dataflow and behavioral modelling of combinational and sequential logic circuits.

Course outcomes

CO1: Apply the knowledge of Boolean algebra and simplification of Boolean expressions to deduce optimal digital networks.
CO2: Study and examine the SSI, MSI and Programmable combinational networks.
CO3: Study and investigate the sequential networks suing counters and shift registers; summarize the performance of logic families with respect to their speed, power consumption, number of ICs and cost.
CO4: Work out SSI and MSI digital networks given a state di agram based on Mealy and Moore configurations.
CO5: Code combinational and sequential networks using Virology HDL.

Text Books

1. Wakerly J F, “Digital Design: Principles and Practices, Prentice-Hall”, 2nd Ed., 2002.
2. D. D. Givone, “Digital Principles and Design”, Tata Mc-Graw Hill, New Delhi, 2003.
3. S.Brown and Z.Vranesic, “Fundamentals of Digital Logic with Verilog Design”, Tata Mc-

Graw Hill, 2008.

Reference Books

1. D.P. Leach, A. P. Malvino, GoutamGuha, "Digital Principles and Applications", Tata Mc-Graw Hill, New Delhi, 2011.
2. M. M. Mano, "Digital Design", 3rd ed., Pearson Education, Delhi, 2003.
3. R.J.Tocci and N.S.Widner, "Digital Systems - Principles& Applications", PHI, 10th Ed., 2007 .
4. Roth C.H., "Fundamentals of Logic Design", Jaico Publishers. V Ed., 2009.
5. T. L. Floyd and Jain ,"Digital Fundamentals", 8th ed., Pearson Education, 2003.

Course Code	**:**	**ECLR31**
Course Title	**:**	**Devices and Networks Laboratory**
Number of Credits	**:**	**2**
Prerequisites (Course code)	**:**	**ECPC32 & ECPC34**
Course Type	**:**	**ELR**

List of Experiments:

1. Study Experiment
2. PN Junction Diode Characteristics
3. Zener diode characteristics and its application
4. Characteristics study of Bipolar Junction Transistor (BJT)
5. Characteristics study of JFET
6. Response study of Series RLC
7. Constant K High pass Filter
8. Attenuators
9. Equalizers
10. Clippers and Clampers
11. SCR Characteristics
12. LAB view implementation

Course Code	**:**	**ECLR32**
Course Title	**:**	**Digital Electronics Laboratory**
Number of Credits	**:**	**2**
Prerequisites (Course code)	**:**	**ECPC35**
Course Type	**:**	**ELR**

List of Experiments:

1. Study of logic gates and verification of Boolean Laws.
2. Design of adders and subtractors.
3. Design of code converters.
4. Design of Multiplexers.
5. Design of De-multiplexers.
6. Design of Encoder and Decoder.
7. 2-bit and 8-bit magnitude comparators.
8. Study of flip-flops.
9. Design and implementation of counters using flip-flops.
10. Design and implementation of shift registers.

FOURTH SEMESTER

Course Code	**:**	**MAIR45**
Course Title	**:**	**Probability Theory and Random Processes**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**MAIR 34**
Course Type	**:**	**GIR**

Course Learning Objectives

- To expose the students to the basics of probability theory and random processes essential for their subsequent study of analog and digital communication.

Course Content

Axioms of probability theory. Probability spaces. Joint and conditional probabilities. Bayes' Theorem-Independent events.

Random variables and random vectors. Distributions and densities. Independent random variables. Functions of one and two random variables.

Moments and characteristic functions. Inequalities of Chebyshev and Schwartz. Convergence concepts.

Random processes. Stationarity and ergodicity. Strict sense and wide sense stationary processes. Covariance functions and their properties. Spectral representation. Wiener-Khinchine theorem.

Gaussian processes. Processes with independent increments. Poisson processes. Low pass and Band pass noise representations.

Course outcomes

CO1: understand the axiomatic formulation of modern Probability Theory and think of random variables as an intrinsic need for the analysis of random phenomena.

CO2: characterize probability models and function of random variables based on single & multiples random variables.

CO3: evaluate and apply moments & characteristic functions and understand the concept of inequalities and probabilistic limits.

CO4: understand the concept of random processes and determine covariance and spectral density of stationary random processes.

CO5: demonstrate the specific applications to Poisson and Gaussian processes and representation of low pass and band pass noise models.

Text Books

1. Davenport," Probability and Random Processes for Scientist and Engineers", McGraw-Hill, 1970.
2. Papoulis. A.," Probability, Random variables and Stochastic Processes", McGraw Hill, 2002.

Reference Books

1. E.Wong, "Introduction to Random Processes", Springer Verlag,1983.
2. W.A.Gardner, "Introduction to Random Processes", (2/e), McGraw Hill,1990.
3. H.Stark & J.W.Woods, "Probability, Random Processes and Estimations Theory for Engineers", (2/e), Prentice Hall, 1994.

Course Code	**:**	**HSIR14**
Course Title	**:**	**Professional Ethics**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**GIR**

PROFESSIONAL ETHICS: This Course will be provided by the Department of Humanities

Course Code	**:**	**ECPC41**
Course Title	**:**	**Digital Signal Processing**
Number of Credits		**4**
Prerequisites (Course code)	**:**	**ECPC31**
Course Type	**:**	**PC**

Course Learning Objectives

- The subject aims to introduce the mathematical approach to manipulate discrete time signals, which are useful to learn digital tele-communication.

Course Content

Review of VLSI system theory, DTFT, Frequency response of discrete time systems, All pass inverse and minimum phase systems.

DFT, Relationship of DFT to other transforms, FFT, DIT and DIF, FFT algorithm, Linear filtering using DFT and FFT.

Frequency response of FIR filter types, Design of FIR filters, IIR filter design, Mapping formulas, Frequency transformations.

Direct form realization of FIR and IIR systems, Lattice structure for FIR and IIR systems, Finite-word length effects. Limit cycle oscillations.

Sampling rate conversion by an integer and rational factor, Poly phase FIR structures for sampling rate conversion.

Course outcomes

CO1: analyze discrete-time systems in both time & transform domain and also through pole-zero placement.
CO2: analyze discrete-time signals and systems using DFT and FFT.
CO3: design and implement digital finite impulse response (FIR) filters.
CO4: design and implement digital infinite impulse response (IIR) filters.
CO5: understand and develop multirate digital signal processing systems.

Text Books

1. J.G.Proakis, D.G. Manolakis, "Digital Signal Processing", (4/e) Pearson, 2007.
2. A.V.Oppenheim&R.W.Schafer, " Discrete Time Signal processing", (2/e),Pearson Education, 2003.
3. S.K.Mitra, "Digital Signal Processing (3/e)", Tata McGraw Hill, 2006.

Reference Books

1. P.S.R.Diniz, E.A.B.da Silva and S.L.Netto, " Digital Signal Processing", Cambridge,2002.
2. E.C.Ifeachor&B.W.Jervis, "Digital Signal Processing", (2/e), Pearson Education, 2002.
3. J.R.Jhonson, "Introduction to Digital Signal Processing", Prentice-Hall, 1989.

Course Code	**:**	**ECPC42**
Course Title	**:**	**Transmission Lines and Waveguides**
Number of Credits		**3**
Prerequisites (Course code)	**:**	**ECPC33**
Course Type	**:**	**PC**

Course Learning Objectives

- To expose students to the complete fundamentals and essential feature of waveguides, resonators and microwave components and also able to give an introduction to microwave integrated circuit design.

Course Content

Classification of guided wave solutions-TE, TM and TEM waves.Field analysis transmission lines.

Rectangular and circular waveguides. Excitation of waveguides. Rectangular and circular cavity resonators.

Transmission line equations.Voltage and current waves.Solutions for different terminations.Transmission-line loading.

Impedance transformation and matching.Smith Chart, Quarter-wave and half-wave transformers.Binomial and Tchebeyshev transformers. Single, double and triple stub matching .

Microstriplines, stripline, slot lines, coplanar waveguide and fin line. Micro strip MIC design aspects. Computer- aided analysis and synthesis.

Course outcomes

CO1: classify the Guided Wave solutions -TE, TM, and TEM.
CO2: analyze and design rectangular waveguides and understand the propagation of electromagnetic waves.
CO3: evaluate the resonance frequency of cavity Resonators and the associated modal field.
CO4: analyze the transmission lines and their parameters using the Smith Chart.
CO5: apply the knowledge to understand various planar transmission lines.

Text Books

1. D.M.Pozar, “Microwave Engineering (3/e)” Wiley,2004.
2. J.D.Ryder, “Networks, Lines and Fields”, PHI, 2003.

Reference Books

1. R.E.Collin, “Foundations for Microwave Engineering (2/e)”, McGraw-Hill,2002.
2. S.Y.Liao , “ Microwave Devices and Circuits”,(3/e) PHI, 2005.
3. J. A. Seeger, “Microwave Theory, Components, and Devices” Prentice-Hall-A division of Simon & Schuster Inc Englewood Cliffs, New Jersy 07632, 1986.

Course Code	**:**	**ECPC43**
Course Title	**:**	**Electronic Circuits**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC34**
Course Type	**:**	**PC**

Course Learning Objectives

- To make the students understand the fundamentals of electronic circuits.

Course Content

Load line, operating point, biasing methods for BJT and MOSFET. Low frequency and high models of BJT and MOSFET, Small signal Analysis of CE, CS, CD and Cascode amplifier

MOSFET amplifiers: Current mirrors: Basic current mirror, Cascode current mirror, Single-ended amplifiers: CS amplifier – with resistive load, diode connected load, current source load, triode load, source degeneration. CG and CD amplifiers, Cascode amplifier,

Frequency response of amplifiers, Differential Amplifiers, CMRR, Differential amplifiers with active load, Two stage amplifiers

Feedback concept, Properties, Feedback amplifiers, Stability analysis, Condition for oscillation, Sinusoidal oscillators.

Power amplifiers- class A, class B, class AB, Biasing circuits, class C and class D

Course outcomes

CO1: illustrate about rectifiers, transistor and FET amplifiers and its biasing. Also compare the performances of its low frequency models.

CO 2: discuss about the frequency response of MOSFET and BJT amplifiers.

CO 3: illustrate about MOS and BJT differential amplifiers and its characteristics.

CO4: discuss about the feedback concepts and construct feedback amplifiers and oscillators. Also summarizes its performance parameters.

CO 5: explain about power amplifiers and its types and also analyze its characteristics.

Text Books

1. A.S.Sedra &K.C.Smith, "Microelectronic Circuits (5/e)", Oxford, 2004.
2. D.L.Schilling&C.Belove,"Electronic Circuits: Discrete and Integrated", (3/e), McGraw Hill, 1989.

Reference Books

1. J.Millman&A., "Microelectronics", McGraw Hill, 1987.
2. K.V.Ramanan, "Functional Electronics" ,Tata McGraw Hill ,1984.

Course Code	**:**	**ECPC44**
Course Title	**:**	**Microprocessors and Micro Controllers**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC35**
Course Type	**:**	**PC**

Course Learning Objectives

This subject deals about the basics of 16-bit Microprocessor, 8-bit and 16-bit Micro controllers, their architectures, internal organization and their functions, peripherals, and interfacing.

Course Content

Microprocessor based personal computer system. Software model of 8086. Segmented memory operation. Instruction set. Addressing modes. Assembly language programming. Interrupts. Programming with DOS and BIOS function calls.

Hardware detail of 8086. . Bus timing. Minimum vs Maximum mode of operation. Memory interface. Parallel and serial data transfer methods. 8255 PPI chip. 8259 Interrupt controller. 8237 DMA controller.

Microcontroller. Von-Neumann Vs Harvard architecture. Programming model. Instruction set of 8051 Microcontroller. Addressing modes. Programming. Timer operation.

Mixed Signal Microcontroller: MSP430 series. Block diagram. Address space. On-chip peripherals -analog and digital. Register sets. Addressing Modes. Instruction set. Programming. FRAM vs flash for low power and reliability.

Peripheral Interfacing using 8051 and Mixed signal microcontroller. Serial data transfer - UART, SPI and I2C. Interrupts. I/O ports and port expansion. DAC, ADC, PWM, DC motor, Stepper motor and LCD interfacing.

Course outcomes

CO1: recall and apply the basic concept of digital fundamentals to Microprocessor based personal computer system.
CO2: identify the detailed s/w & h/w structure of the Microprocessor.
CO3: illustrate how the different peripherals are interfaced with Microprocessor.
CO4: distinguish and analyze the properties of Microprocessors & Microcontrollers.
CO5: analyze the data transfer information through serial & parallel ports.
CO6: train their practical knowledge through laboratory experiments.

Text Books

1. J.L.Antonakos, "An Introduction to the Intel Family of Microprocessors", Pearson, 1999.
2. M.A.Mazidi&J.C.Mazidi "Microcontroller and Embedded systems using Assembly & C. (2/e)", Pearson Education, 2007.
3. ***John H. Davies, "*** MSP430 Microcontroller Basics", Elsevier Ltd., 2008

Reference Books

1. B.B. Brey, "The Intel Microprocessors, (7/e), Eastern Economy Edition" , 2006.
2. K.J. Ayala, "The 8051 Microcontroller ", (3/e), Thomson Delmar Learning, 2004.
3. S. MacKenzie and R.C.W.Phan., " The 8051 Microcontroller.(4/e)", Pearson education, 2008.

Course Code	**:**	**ECLR41**
Course Title	**:**	**Electronic Circuits Laboratory**
Number of Credits	**:**	**2**
Prerequisites (Course code)	**:**	**ECPC43**
Course Type	**:**	**ELR**

List of Experiments:

Hardware Experiments

1. Stability of Q point
2. Single stage RC coupled CE amplifier
3. Single stage RC coupled Current series CE feedback amplifier
4. Darlington emitter follower
5. Differential Amplifier
6. RC phase shift oscillator
7. Colpitt's Oscillator
8. Power amplifier – Class A & class AB

Simulation Experiments

9. MOS CS amplifier with resistive load, diode connected load, current source load
10. MOS current mirrors

Course Code	**:**	**ECLR42**
Course Title	**:**	**Microprocessor and Microcontroller Laboratory**
Number of Credits	**:**	**2**
Prerequisites (Course code)	**:**	**ECPC44**
Course Type	**:**	**ELR**

List of Experiments

Intel 8086 – 16bit µP- Emulator.

1. Addressing modes of 8086 Microprocessor .
2. Block move and simple arithmetic operations .
3. Identification and displaying the activated key using DOS and BIOS function calls.

Intel 8051 (8-bit Microcontroller) - Proteus VSM Simulator and Trainer Kit

4. Addressing modes of 8051 Microcontroller.
5. Delay generation - i) Nested loop and ii) Timers.
6. Toggling the ports and counting the pulses.
7. LCD Interfacing.
8. Generation of different waveforms using DAC (0808)
9. ADC interfacing.

Mixed-Signal Microcontroller – 16bit – MSP430 series

10. PWM generation and speed control of Motors using MSP430.

FIFTH SEMESTER

Course Code	**:**	**ECPC51**
Course Title	**:**	**Statistical Theory of Communication**
Number of Credits	**:**	**4**
Prerequisites (Course code)	**:**	**MAIR45**
Course Type	**:**	**PC**

Course Learning Objectives

- The subject aims to make the students to understand the statistical theory of telecommunication, which are the basics to learn analog and digital telecommunication.

Course Content

Information measure. Discrete entropy. Joint and conditional entropies. Uniquely decipherable and instantaneous codes. Kraft-Mcmillan inequality. Noiseless coding theorem. Construction of optimal codes.

DMC. Mutual information and channel capacity. Shannon's fundamental theorem. Entropy in the continuous case. Shannon-Hartley law.

Binary hypothesis testing. Baye's, minimax and Neyman-Pearson tests. Random parameter estimation-MMSE,MMAE and MAP estimates. Nonrandom parameters – ML estimation.

Coherent signal detection in the presence of additive white and non-white Gaussian noise.Matched filter.

Discrete optimum linear filtering. Orthogonality principle. Spectral factorization. FIR and IIR Wiener filters.

Course outcomes

CO1: show how the information is measured and able to use it for effective coding.
CO2: summarize how the channel capacity is computed for various channels.
CO3: use various techniques involved in basic detection and estimation theory to solve the problem.
CO4: summarize the applications of detection theory in telecommunication.
CO5: summarize the application of estimation theory in telecommunication.

Text Books

1. R.B.Ash," Information Theory", Wiley,1965.
2. M.D.Srinath, P.K.Rajasekaran&R.Viswanathan, "Statistical Signal Processing with Applications", PHI 1999.

Reference Books

1. H.V.Poor, "An Introduction to Signal Detection and Estimation,(2/e)", Spring Verlag.1994.
2. M.Mansuripur , " Introduction to Information Theory", Prentice Hall.1987.
3. J.G.Proakis, D G Manolakis, "Digital Signal Processing", (4/e), Pearson Education, 2007.

Course Code	**:**	**ECPC52**
Course Title	**:**	**Digital Signal Processors and Applications**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC41**
Course Type	**:**	**PC**

Course Learning Objectives

- To give an exposure to the various fixed point and floating point DSP architectures, to understand the techniques to interface sensors and I/O circuits and to implement applications using these processors.

Course Content

Fixed-point DSP architectures. Basic Signal processing system. Need for DSPs. Difference between DSP and other processor architectures. TMS320C54X, ADSP21XX, DSP56XX architecture details. Addressing modes. Control and repeat operations. Interrupts. Pipeline operation. Memory Map and Buses.

Floating-point DSP architectures. TMS320C3X, DSP96XX architectures. Cache architecture. Floating-point Data formats. On-chip peripherals. Memory Map and Buses.

On-chip peripherals. Hardware details and its programming. Clock generator with PLL. Serial port. McBSP. Parallel port. DMA. EMIF. I^2C. Real-time-clock(RTC). Watchdog timer.

Interfacing. Serial interface- Audio codec. Sensors - Humidity/temperature sensor, flow sensor, accelerometer, pulse sensor and finger print scanner. A/D and D/A interfaces. Parallel interface- Memory interface. RF transceiver interface – Wi-Fi and Zigbee modules.

DSP tools and applications. Implementation of Filters, DFT, QPSK Modem, Speech processing. Video processing, Video Encoding/Decoding. Biometrics. Machine Vision. High performance computing (HPC).

Course outcomes

CO1: learn the architecture details of fixed point DSPs.
CO2: learn the architecture details of floating point DSPs
CO3: infer about the control instructions, interrupts, pipeline operations, memory and buses.
CO4: illustrate the features of on-chip peripheral devices and its interfacing with real time application devices.
CO5: learn to implement the signal processing algorithms and applications in DSPs

Text Books

1. B.Venkataramani&M.Bhaskar, "Digital Signal Processor, Architecture, Programming and Applications",(2/e), McGraw- Hill,2010
2. S.Srinivasan&Avtar Singh, "Digital Signal Processing, Implementations using DSP Microprocessors with Examples from TMS320C54X", Brooks/Cole, 2004.

Reference Books

1. S.M.Kuo&W.S.S.Gan," Digital Signal Processors: Architectures, Implementations, and Applications", Printice Hall, 2004
2. C.Marven&G.Ewers, "A Simple approach to digital signal processing", Wiley Inter science, 1996.
3. R.A.Haddad&T.W.Parson, "Digital Signal Processing: Theory, Applications and Hardware", Computer Science Press NY, 1991.

Course Code	**:**	**ECPC53**
Course Title	**:**	**Analog Communication**
Number of Credits		**3**
Prerequisites (Course code)	**:**	**ECPC31**
Course Type	**:**	**PC**

Course Learning Objectives

- To develop a fundamental understanding on Communication Systems with emphasis on analog modulation techniques and noise performance.

Course Content

Basic blocks of Communication System. Amplitude (Linear) Modulation – AM, DSB-SC, SSB-SC and VSB-SC. Methods of generation and detection. FDM. Super Heterodyne Receivers.

Angle (Non-Linear) Modulation - Frequency and Phase modulation. Transmission Bandwidth of FM signals, Methods of generation and detection. FM Stereo Multiplexing.

Noise - Internal and External Noise, Noise Calculation, Noise Figure. Noise in linear and nonlinear AMreceivers, Threshold effect.

Noise in FM receivers, Threshold effect, Capture effect, FM Threshold reduction, Pre-emphasis and De-emphasis.

Pulse Modulation techniques – Sampling Process, PAM, PWM and PPM concepts, Methods of generation and detection. TDM. Noise performance.

Course outcomes

CO1: Understand the basics of communication system and analog modulation techniques

CO2: Apply the basic knowledge of signals and systems and understand the concept of Frequency modulation.

CO3: Apply the basic knowledge of electronic circuits and understand the effect of Noise in communication system and noise performance of AM system

CO4: Understand the effect of noise performance of FM system.

CO5: Understand TDM and Pulse Modulation techniques.

Text Books

1. S.Haykins, Communication Systems , Wiley, (4/e), Reprint 2009.
2. Kennedy, Davis, Electronic Communication Systems (4/e), McGraw Hill, Reprint 2008.

Reference Books

1. B.Carlson, Introduction to Communication Systems, McGraw-Hill, (4/e), 2009.
2. J.Smith, Modern Communication Circuits (2/e), McGraw Hill, 1997.
3. J.S.Beasley&G.M.Miler, Modern Electronic Communication (9/e), Prentice-Hall, 2008.

Course Code	**:**	**ECPC54**
Course Title	**:**	**Analog Integrated Circuits**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC43**
Course Type	**:**	**PC**

Course Learning Objectives

- To introduce the theoretical & circuit aspects of an Op-amp.

Course Content

Operational Amplifiers, DC and AC characteristics, Typical op-amp parameters: Finite gain, finite bandwidth, Offset voltages and currents, Common-mode rejection ratio, Power supply rejection ratio, Slew rate, Applications of Op-amp: Precision rectifiers. Summing amplifier, Integrators and differentiators, Log and antilog amplifiers. Instrumentation amplifiers, voltage to current converters.

Active filters: Second order filter transfer function (low pass, high pass, band pass and band reject), Butterworth, Chebyshev and Bessel filters. Switched capacitor filter. notch filter, All pass filters, self-tuned filters

Opamp as a comparator, Schmitt trigger, Astable and monostable multivibrators, Triangular wave generator, Multivibrators using 555 timer, Data converters: A/D and D/A converters

PLL- basic block diagram and operation, Four quadrant multipliers. Phase detector, VCO, Applications of PLL:Frequency synthesizers, AM detection, FM detection and FSK demodulation.

CMOS differential amplifiers**:** DC analysis and small signal analysis of differential amplifer with Restive load, current mirror load and current source load, Input common-mode range and Common-mode feedback circuits. OTAs vs Opamps. Slew rate, CMRR, PSRR. Two stage amplifiers, Compensation in amplifiers (Dominant pole compensation).

Course outcomes

CO1: infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.

CO2: elucidate and design the linear and non linear applications of an opamp and special application Ics.

CO3: explain and compare the working of multi vibrators using special application IC 555 and general purpose opamp.

CO4: classify and comprehend the working principle of data converters.

CO5: illustrate the function of application specific ICs such as Voltage regulators, PLL and its application in communication.

Text Books

1. S.Franco, Design with Operational Amplifiers and Analog Integrated Circuits (3/e) TMH, 2003.
2. Sedra and Smith, Microelectronics Circuits, Oxford Univ. Press, 2004
3. Coughlin, Driscoll, OP-AMPS and Linear Integrated Circuits, Prentice Hall, 2001.

Course Code	**:**	**ECLR51**
Course Title	**:**	**Analog Integrated Circuits Laboratory**
Number of Credits	**:**	**2**
Prerequisites (Course code)	**:**	**ECPC54**
Course Type	**:**	**ELR**

List of Experiments:

HardwareExperiments

1. Study the characteristics of negative feedback amplifier
2. Design of an instrumentation amplifier
3. Study the characteristics of regenerative feedback system-Schmitt trigger
4. Study the characteristics of integrator circuit
5. Design of a second order butterworth band-pass filter for the given higher and lower cut-off frequencies
6. Design of a high-Q Band pass self-tuned filter for a given center frequency
7. Design of a function generator- Square, Triangular
8. Design of a Voltage Controlled Oscillator
9. Design of a Phase Locked Loop(PLL) (Mini project)

SimulationExperiments

DC and small signal analysis of differential amplifer with Restive load, current mirror load and current source load, Input common-mode range and Common-mode feedback circuits, CMRR, PSRR.

Course Code	**:**	**ECLR52**
Course Title	**:**	**Digital Signal Processing and Simulation Laboratory**
Number of Credits	**:**	**2**
Prerequisites (Course code)	**:**	**ECPC41 & ECPC52**
Course Type	**:**	**ELR**

List of Experiments:

MATLAB Experiments

1. Realization of correlation of two discrete signals
2. Realization of sub band filter using linear convolution
3. Design and implementation of FIR filter
4. Design and implementation of IIR filter
5. Realization of STFT using FFT
6. Demonstration of Bayes technique
7. Demonstration of Min-max technique
8. Realization of FIR Wiener filter

TMS320C54X Processor Experiments

9. Study of various addressing modes
10. Sequence generation and number sorting
11. Convolution using overlap add and overlap save methods
12. Wave pattern generation
13. FIR filter implementation

SIXTH SEMESTER

Course Code	**:**	**ECPC61**
Course Title	**:**	**Digital Communication**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC51**
Course Type	**:**	**PC**

Course Learning Objectives

- To understand the key modules of digital communication systems with emphasis on digital modulation techniques.
- To get introduced to the basics of source and channel coding/decoding and Spread Spectrum Modulation.

Course Content

Base band transmission. Sampling theorem, Pulse code modulation (PCM), DM, Destination SNR in PCM systems with noise. Matched filter. Nyquist criterion for zero ISI. Optimum transmit and receive filters. Correlative Coding, M-ary PAM. Equalization- zero-forcing and basics of adaptive linear equalizers.

BASK, BFSK, and BPSK- Transmitter, Receiver, Signal space diagram, Error probabilities.

M-ary PSK, M-ary FSK, QAM, MSK and GMSK- Optimum detector, Signal constellation, error probability.

Linear block codes-Encoding and decoding. Cyclic codes – Encoder, Syndrome Calculator. Convolutional codes – encoding ,Viterbi decoding. TCM.

Spread Spectrum (SS) Techniques- Direct Sequence Spread Spectrum modulation, Frequency-hop Spread Spectrum modulation - Processing gain and jamming margin.

Course outcomes

CO1: Apply the knowledge of signals and system and explain the conventional digital communication system.

CO2: Apply the knowledge of statistical theory of communication and evaluate the performance of digital communication system in the presence of noise.

CO3: Describe and analyze the performance of advance modulation techniques.

CO4: Apply the knowledge of digital electronics and describe the error control codes like block code, cyclic code.

CO5: Describe and analyze the digital communication system with spread spectrum modulation.

Text Books

1. S.Haykin, “Communication Systems”, Wiley,(4/e),2001.
2. J.G.Proakis, “Digital Communication” , Tata McGraw – Hill,(4/e),2001.

Reference Books

1. B.Sklar, “Digital Communications: Fundamentals & Applications”, Pearson Education, (2/e), 2001.
2. A.B.Carlson, “ Communication Systems”, McGraw Hill, 3/e,2002
3. R.E.Zimer & R.L.Peterson,” Introduction to Digital Communication”, PHI,3/e, 2001

Course Code	**:**	**ECPC62**
Course Title	**:**	**Wireless Communication**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**PC**

Course Learning Objectives

- To get an understanding of mobile radio communication principles, types and to study the recent trends adopted in cellular and wireless systems and standards**.**

Course Content

Introduction to Wireless Communication. Cellular concept. System design fundamentals. Coverage and Capacity improvement in Cellular system. Technical Challenges.

Mobile Radio Propagation; Reflection, Diffraction, Fading. Multipath propagation. Statistical characterization of multipath fading. Diversity Techniques.

Path loss prediction over hilly terrain. Practical link budget design using Path loss models. Design parameters at base station. Antenna location, spacing, heights and configurations.

Multiple access techniques; FDMA, TDMA and CDMA. Spread spectrum. Power control. WCDMA. CDMA network design. OFDM and MC-CDMA.

GSM.3G, 4G(LTE), NFC systems, WLAN technology. WLL. HiperLAN. Ad hoc networks. Bluetooth.

Course outcomes

CO1: Apply the knowledge of basic communication systems and its principles.
CO2: Describe the cellular concept and analyze capacity improvement Techniques.
CO3: Mathematically analyze mobile radio propagation mechanisms.
CO4: Summarize diversity reception techniques.
CO5: Design Base Station (BS) parameters and analyze the antenna configurations.
CO6: Analyze and examine the multiple access techniques and its application.
CO7: Assess the latest wireless technologies.

Text Books:

1. T.S.Rappaport, Wireless Communication Principles (2/e), Pearson, 2002.
2. A.F.Molisch, Wireless Communications, Wiley, 2005.

Reference Books:

1. P.MuthuChidambaraNathan, Wireless Communications, PHI, 2008.
2. W.C.Y.Lee, Mobile Communication Engineering. (2/e), McGraw- Hill,1998.
3. A.Goldsmith, Wireless Communications, Cambridge University Press, 2005.
4. *S.G.Glisic, Adaptive CDMA, Wiley, 2003.*

Course Code	**:**	**ECPC63**
Course Title	**:**	**VLSI Systems**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC35**
Course Type	**:**	**PC**

Course Learning Objectives

- To introduce various aspects of VLSI circuits and their design including testing**.**

Course Content

VLSI design methodology, VLSI technology- NMOS, CMOS and BICMOS circuit fabrication. Layout design rules. Stick diagram. Latch up.

Characteristics of MOS and CMOS switches. Implementation of logic circuits using MOS and CMOS technology, multiplexers and memory, MOS transistors, threshold voltage, MOS device design equations. MOS models, small-signal AC analysis. CMOS inverters, propagation delay of inverters, Pseudo NMOS, Dynamic CMOS logic circuits, power dissipation.

Programmable logic devices- antifuse, EPROM and SRAM techniques. Programmable logic cells.Programmable inversion and expander logic. Computation of interconnect delay, Techniques for driving large off-chip capacitors, long lines, Computation of interconnect delays in FPGAs Implementation of PLD, EPROM, EEPROM, static and dynamic RAM in CMOS.

An overview of the features of advanced FPGAs, IP cores, Softcore processors, Various factors determining the cost of a VLSI, Comparison of ASICs, FPGAs , PDSPs and CBICs . Fault tolerant VLSI architectures

VLSI testing -need for testing , manufacturing test principles, design strategies for test, chip level and system level test techniques.

Course outcomes

CO1: Describe the techniques used for VLSI fabrication, design of CMOS logic circuits, switches and memory

CO2: Describe the techniques used the design of CMOS logic circuits, switches and memory in VLSI

CO3: Generalize the design techniques and analyze the characteristics of VLSI circuits such as area, speed and power dissipation

CO4: Explain and compare the architectures for FPGA, PAL and PLDs and evaluate their characteristics such as area, power dissipation and reliability

CO4: Use the advanced FPGAs to realize Digital signal processing systems

CO5: Describe the techniques for fault tolerant VLSI circuits

CO6: Explain and compare the techniques for chip level and board level testing

Text Books

1. N. H. E. Weste, D.F. Harris, “CMOS VLSI design”, (3/e), Pearson , 2005.
2. J. Smith, “Application Specific Integrated Circuits,Pearson”, 1997.
3. M.M.Vai, “VLSI design”, CRC Press, 2001.

Reference Books

1. Pucknell & Eshraghian, “Basic VLSI Design”, PHI, (3/e), 2003.
2. Uyemura, “Introduction to VLSI Circuits and Systems”, Wiley, 2002.

Course Code	**:**	**ECPC64**
Course Title	**:**	**Antennas and Propagation**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC33**
Course Type	**:**	**PC**

Course Learning Objectives

- To impart knowledge on basics of antenna theory and to analyze and design a start of art antenna for wireless communications.

Course Content

Radiation fundamentals. Potential theory. Helmholtz integrals. Radiation from a current element. Basic antenna parameters. Radiation field of an arbitrary current distribution. Small loop antennas.

Receiving antenna. Reciprocity relations. Receiving cross section, and its relation to gain. Reception of completely polarized waves. Linear antennas. Current distribution. Radiation field of a thin dipole. Folded dipole. Feeding methods. Baluns.

Antenna arrays. Array factorization. Array parameters. Broad side and end fire arrays. Yagi-Uda arrays Log-periodic arrays.

Aperture antennas. Fields as sources of radiation. Horn antennas. Babinet's principle. Parabolic reflector antenna. Microstrip antennas.

Wave Propagation: Propagation in free space. Propagation around the earth, surface wave propagation, structure of the ionosphere, propagation of plane waves in ionized medium, Determination of critical frequency, MUF. Fading, tropospheric propagation, Super refraction.

Course outcomes

CO1: select the appropriate portion of electromagnetic theory and its application to antennas.

CO2: distinguish the receiving antennas from transmitting antennas, analyze and justify their characteristics.

CO3: assess the need for antenna arrays and mathematically analyze the types of antenna arrays.

CO4: distinguish primary from secondary antennas and analyze their characteristics by applying optics and acoustics principles.

CO5: outline the factors involved in the propagation of radio waves using practical antennas.

Text Books

1. R.E.Collin, "Antennas and Radio Wave Propagation", McGraw – Hill,1985.
2. W.L.Stutzman&G.A.Thiele , "Antenna Theory and Design", Wiley.

Reference Books

1. K.F.Lee, "Principles of Antenna Theory", Wiley,1984.
2. F.E. Terman , "Electronic Radio Engineering (4/e)", McGraw Hill.
3. J.R. James, P. S. Hall, and C. Wood, "Microstrip Antenna Theory and Design", IEE, 1981.
4. C. A.Balanis,"Modern Antenna Handbook", Wiley India Pvt. Limited, 2008.

Course Code	**:**	**ECLR61**
Course Title	**:**	**Communication Engineering Laboratory**
Number of Credits	**:**	**2**
Prerequisites (Course code)	**:**	**ECPC53 & ECPC61**
Course Type	**:**	**ELR**

List of Experiments:

1. AM Modulation and Demodulation
2. DSB-SC Modulation
3. Pulse Amplitude Modulation and Demodulation
4. Pulse Width Modulation and Demodulation
5. Pulse Position Modulation using PLL(IC 565)
6. Amplitude Shift Keying (ASK) Modulation and Demodulation
7. Frequency Shift Keying (FSK) Modulation and Demodulation
8. Frequency Multiplier using PLL
9. Analog and digital modulation using COMMSIM simulation tool
10. Analog and digital modulation using MATLAB
11. Study of wireless communication system using Wi-Comm Kit

Course Code	**:**	**ECLR62**
Course Title	**:**	**VLSI and Embedded System Design Laboratory**
Number of Credits	**:**	**2**
Prerequisites (Course code)	**:**	**ECPC63**
Course Type	**:**	**ELR**

List of Experiments:

USING QUARTUS II

1. Adders and subtractors
2. Mux &Demux
3. Encoders & Decoders
4. Flip-Flops
5. Shift-Registers & Counters

USING XILINX

6. Working with RAM
7. Comparators, parity generators & ALU
8. Counters and Shift Registers
9. Carry look ahead adder
10. MULTIPLIERS

WARP DESIGN

Lab1: Introduction to WARP Design Flows
Lab2: Building a Simple Transmitter
Lab3: Building a Simple and Unidirectional MAC
Lab4: Building a single-carrier streaming PHY.

SEVENTH SEMESTER

Course Code	**:**	**ECPC71**
Course Title	**:**	**Microwave Components and Circuits**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC42**
Course Type	**:**	**PC**

Course Learning Objectives

- The subject introduces the essential Microwave Circuit Theory and the design aspects of Microwave Integrated Circuit components.

Course Content

Scattering matrix formulation.Passive microwave devices; terminations, bends, corners, attenuators, phase changers, directional couplers and hybrid junctions. Basics and design considerations of Microstripline, strip line, coplanar waveguide, Slot line and Finline.

Microwave measurements; frequency, wavelength, VSWR.I mpedance determination.S-parameter measurements. Network analyzer.

Microwave network parameters. Basic circuit elements for microwaves. Transmission line sections and stubs.Richardtransformation.Kuroda identities.

MIC filter design. Low pass to high pass, band pass and band stop transformations. Realization using microstriplines and strip lines.

Design and realization of MIC components.3 dB hybrid design. Ratrace Hybrid Ring, Backward wave directional coupler, power divider; realization using microstrip lines and strip lines.

Course outcomes

CO1: Learn the basics of S parameters and use them in describing the components
CO2: Expose to the Microwave Measurements Principle
CO3: Realize the importance of the theory of Microwave circuit theory.
CO4: Work out the complete design aspects of various M.I.C. Filters
CO5: Confidently design all M.I.C. components to meet the industry standard

Text Books

1. I.J.Bahl&P.Bhartia, "Microwave Solid state Circuit Design", Wiley, 2003.
2. D.M.Pozar, "Microwave Engineering (2/e)", Wiley, 2004.

Reference Books

1. A. Das, "Microwave Engineering", Tata McGraw Hill, 2000
2. B.Bhat, S. K. Koul,,"Stripline like transmission lines for Microwave Integrated Circuits", New age International Pvt.Ltd. Publishers 2007.
3. G. Matthaei , E.M.T. Jones , L. Young , George Matthaei , Leo Young , George L. Matthaei "Microwave filters, Impedance Matching Network, Coupling Structures (Updated)",Hardcover, 1,096 Pages, Published 1980 by Artech House Publishers ISBN-13: 978-0-89006-099-5, ISBN: 0-89006-099-1

Course Code	**:**	**HSIR13**
Course Title	**:**	**Industrial Economics and Foreign Trade**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**GIR**

INDUSTRIAL ECONOMICS AND FOREIGN TRADE: This Course will be provided by the Department of Humanities.

EIGHTH SEMESTER

Course Code	**:**	**ECPC81**
Course Title	**:**	**Fiber Optic Communication**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC33 & ECPC53**
Course Type	**:**	**PC**

Course Learning Objectives

- To expose the students to the basics of signal propagation through optical fibers, fiber impairments, components and devices and system design.

Course Content

Optical Fibers: Structure, Wave guiding. Step-index and graded index optical fibers. Modal analysis.Classification of modes.Single Mode Fibers.

Pulse dispersion. Material and waveguide dispersion.Polarization Mode Dispersion.Absorption, scattering and bending losses. Dispersion Shifted Fibers, Dispersion Compensating Fibers.

Optical Power Launching and Coupling. Lensing schemes for coupling improvement.Fiber-to-fiber joints.Splicingtechniques. Optical fiber connectors.

Optical sources and detectors.Laser fundamentals. Semiconductor Laser basics. LEDs.PIN and Avalanche photodiodes, Optical Tx/Rx Circuits.

Design considerations of fiber optic systems: Analog and digital modulation. Noise in detection process. Bit error rate. Optical receiver operation. Power Budget and Rise time Budget. WDM.

Course outcomes

CO1: Recognize and classify the structures of Optical fiber and types.
CO2: Discuss the channel impairments like losses and dispersion.
CO3: Analyze various coupling losses.
CO4: Classify the Optical sources and detectors and to discuss their principle.
CO5: Familiar with Design considerations of fiber optic systems.

Text Books

1. G.Keiser, "Optical Fiber Communications (5/e)", McGraw Hill ,2013.
2. G.P.Agarwal, "Fiber Optic Communication Systems", (3/e), Wiley, 2002.

Reference Books

1. M.M.K.Liu, "Principles and Applications of Optical Communications", Tata McGeaw Hill, 2010.
2. A.Ghatak&K.Thygarajan, "Introduction to Fiber Optics", Cambridge, 1999.
3. J.Gowar, "Optical Communication Systems", (2/e), PHI, 2001.
4. A.Selvarajan, S.Kar and T.Srinivas, "Optical Fiber Communication Principles and Systems", TataMcGraw Hill, 2002.

PROGRAMME ELECTIVES

Course Code	**:**	**ECPE11**
Course Title	**:**	**Display Systems**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC34**
Course Type	**:**	**PE**

Course Learning Objectives

- To expose the students to the basics of the display systems and to illustrate the current design practices of the display systems.

Course Content

Introduction to displays. Requirements of displays. Display technologies, CRT, Flat panel and advanced display technologies. Technical issues in displays.

Head mounted displays. Displays less than and greater than 0.5 m diagonal. Low power and light emitting displays.

Operation of TFTs and MIMS. LCDs, Brightness. Types of LCD displays.

Emissive displays, ACTFEL, Plasma display and Field emission displays, operating principle and performance.

Types of Displays: 3D, HDTV, LED, Touch screen.

Course outcomes

CO1: appreciate the technical requirement of different types of display systems
CO2: analyze the various low power lighting systems
CO3: understand the operation of TFTs and LCD displays.
CO4: analyze the various kinds of emissive displays
CO5: critically evaluate the recent advancements in the displays device technology.

Text Books

1. L.W. Mackonald& A.C. Lowe, Display Systems, Design and Applications, Wiley,2003.
2. E.H. Stupp&M. S. Brennesholtz, Projection Displays, Wiley,1999

ReferenceBooks

1. Peter A. Keller, Electronic Display Measurement: Concepts, Techniques, and Instrumentation, Wiley-Interscience,1997.

Course Code	**:**	**ECPE12**
Course Title	**:**	**Statistical Signal Processing**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC41**
Course Type	**:**	**PE**

Course learning Objectives

- To develop algorithms for optimum filtering (and prediction) and for adaptive filtering for the given observation processes.
- To enable the students understand the frequency analysis and estimation methods

Course Content

Random processes: Stationary processes, wide-sense stationary processes, autocorrelation and auto covariance functions, Spectral representation of random signals, Wiener Khinchin theorem Properties of power spectral density, Gaussian Process and White noise process, Linear System with random input, Spectral factorization theorem and its importance, innovation process and whitening filter, .Random signal modeling: MA, AR, ARMA models.

Optimum Linear Filtering: Linear Minimum Mean-Square Error (LMMSE) Filtering: Wiener Hoff Equation, FIR Wiener filter, Causal IIR Wiener filter, Non causal IIR Wiener filter, Linear Prediction of Signals, Forward and Backward Predictions, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters.

Adaptive Filtering : Principle and Application, Steepest Descent Algorithm, Convergence characteristics; LMS algorithm, convergence, excess mean square error, Leaky LMS algorithm; Application of Adaptive filters. RLS algorithm: Exponentially weighted RLS algorithm derivation, Matrix inversion Lemma, Initialization.

Spectrum Estimation: Principle of estimation and applications, Properties of estimates, unbiased and consistent estimators, Estimated autocorrelation function, periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Blackman and Tukey method of smoothing periodogram, Prametric method, AR spectral estimation.

Frequency Estimation, Eigen decomposition of Autocorrelation matrix, Detection of Harmonic signals: Pisarenko's method, MUSIC algorithm, ESPRIT method, Propagator method.

Course outcomes

CO1: apply the knowledge of the discrete-time stochastic processes & its measures and understand various stochastic models.

CO2: develop algorithms for optimum linear filtering and prediction for the given observation processes

CO3: develop steepest descent, Least Mean Square (LMS), and Recursive Least Squares (RLS) adaptive filter algorithms

CO4: derive and analyze the statistical properties of the conventional spectral estimators, namely the periodogram, averaged & modified periodogram and Blackman-Tukey methods

CO5: formulate parametric spectral estimators based upon autoregressive (AR), moving average (MA), and autoregressive moving average (ARMA) models, and detail their statistical properties.

CO6: select an appropriate array processing algorithms for frequency estimation based on the observation models.

Text Books

1. M.H. Hayes, “Statistical Digital Signal Processing and Modelling”, John Wiley,1996.
2. P.Stroica & R.Moses,” Spectral Analysis of signals”,Pearson,2005.

Course Code	**:**	**ECPE13**
Course Title	**:**	**Communication Switching Systems**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC53**
Course Type	**:**	**PE**

Course learning Objectives

- To understand the working principles of switching systems from manual and electro mechanical systems to stored program control systems.

Course Content

Basic elements of communication network. Switching systems. Signaling and signaling functions.

Digital telephone network. TDM Principles. PCM primary multiplex group. Plesiochronous digital hierarchy. Synchronous digital hierarchy. Echo cancellers.

Digital transmission and multiplexing. Synchronous versus Asynchronous transmission. Line coding . Error performance. TDM. Framing, TDM loops and rings.

Space division switching. Multiple-stage switching. Design examples. Switching matrix control. Time division switching. Multiple-stage time and space switching.

Timing recovery. Jitter. Network synchronization. Digital subscriber access-ISDN . ADSL. HFC. Traffic analysis.

Course outcomes

CO1: explain the working principle of switching systems involved in telecommunication switching
CO2: assess the need for voice digitization and T Carrier systems
CO3: compare and analyze Line coding techniques and examine its error performance
CO4: design multi stage switching structures involving time and space switching stages
CO5: analyze basic telecommunication traffic theory

Text Books

1. J.C. Bellamy, “Digital Telephony”, Wiley, 3rd edition,2011.
2. J.E. Flood, “Telecommunications Switching, Traffic and Networks” Pearson,1st edition,2012

Reference Books

1. T.Viswanathan, “Telecommunication Switching Systems and Networks”, PHI,2006.
2. E.Keiser&E.Strange, “Digital Telephony and Network Integration”, Springer, 2nd edition,1995.
3. R. L.Freeman, “Fundamentals of Telecommunications” , John Wiley and Sons, 2ndedition,1999.

Course Code	**:**	**ECPE14**
Course Title	**:**	**RF MEMS Circuit Design**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC42 & ECPC71**
Course Type	**:**	**PE**

Course learning Objectives

- To impart knowledge on basics of MEMS and their applications in RF circuit design.

Course Content

Introduction to Micho machining Processes. RF MEMS relays and switches. Switch parameters. Actuation mechanisms. Bistable relays and micro actuators. Dynamics of switching operation.

MEMS inductors and capacitors. Micro machined inductor. Effect of inductor layout. Modeling and design issues of planar inductor. Gap-tuning and area-tuning capacitors. Dielectric tunable capacitors.

MEMS phase shifters. Types. Limitations. Switched delay lines. Fundamentals of RF MEMS Filters. Micro machined transmission lines. Coplanar lines. Micro machined directional coupler and mixer.

Micro machined antennas. Micros trip antennas–design parameters. Micro machining to improve performance. Reconfigurable antennas.

Course outcomes

CO1: learn the Micro machining Processes
CO2: learn the design and applications of RF MEMS inductors and capacitors.
CO3: learn about RF MEMS Filters and RF MEMS Phase Shifters.
CO4: learn about the suitability of micro machined transmission lines for RF MEMS
CO5: learn about the Micro machined Antennas and Reconfigurable Antennas

Text Book

1. Vijay.K.Varadanetal, “RF MEMS and their Applications”, Wiley-India,2011.

Reference Books

1. H.J.D.Santos, “RF MEMS Circuit Design for Wireless Communications”, Artech House,2002.
2. G.M.Rebeiz, “RF MEMS Theory, Design, and Technology”, Wiley,2003.

Course Code	**:**	**ECPE15**
Course Title	**:**	**Principles of Radar**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC51**
Course Type	**:**	**PE**

Course learning Objectives

- To expose the students to the working principles of a radar from a signal processing perspective.

Course content

Radar equation. Radar cross section. Cross section of small targets. Target scattering matrices. Area and volume targets.

Radar signals. Ambiguity function and its properties. Uncertainty principle. Pulse compression. linear FM pulse. Pulse compression by Costas FM and binary phase coding.

Radar detection. Optimum Bayesian decision rules. Detection criteria for different target models.

Range and Doppler measurements and tracking. Range and Doppler frequency resolutions. Optimum receivers. Optimum filters for Doppler measurements. Coherent and non coherent implementations.

Angle measurement and tracking. Angle measurement and tracking by conical scan and mono pulse. Optimum mono pulse systems.

Course outcomes

CO1: Understand the principle behind radar range equation and different types of targets available.
CO2: Appreciate the different compression techniques of radar pulse signals.
CO3: Distinguish between different detection methods of radar signals.
CO4: Appreciate the building blocks for optimum receiver and Doppler measurements.
CO5: Understand the tracking and scanning methods in the mono pulse systems.

Text books:

1. P.Z.Peebles, Radar Principles, Wiley,1998.
2. Merrill I. Skolink, Introduction to Radar Systems, (3/e), Tata MG Graw Hill,2001

Reference Books:

1. N.Levanon, Radar Signals, Wiley,2005.
2. D.Wehnar : High Resolution Radar, Artech Hous,1987.
3. D.K.Barton : Radar systems Analysis , Prentice Hall,1976.

Course Code	**:**	**ECPE16**
Course Title	**:**	**Digital Signal Processing for Wireless Communication**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC41 & ECPC62**
Course Type	**:**	**PE**

Course learning Objectives

- The subject aims to make the students to understand the signal processing approach for wireless communication

Course Content

Physical model for wireless channel- Input /Output models for wireless channel: System function and impulse response of LTV system-Doppler spread-Coherence time-Delay spread-Coherence frequency-Base band system functions and impulse response.

Statistical channel model-Binary detection in flat Rayleigh fading- Non-cohernent detection in flat Rician fading-Channel measurement-Use of probing signals to estimate the channel-Rake receiver-Jakes model- Jakes spectrum-Ground reflections-Okumura model-Log normal shadowing- Hatamodel.

Cellular communication-Frequency reuse- Practical Link budget design using path loss models-Design parameters at base station-Antennal location, spacing, heights and configurations- Tele traffic theory.

Multiple access techniques: TDMA, FDMA, CDMA: PN sequences-Multipath diversity-Rake receiver- Receiver synchronization-Multicarrier modulation. Orthogonal frequency division Multiplexing (OFDM): Cyclic prefix-Frequency offset-Peak to average power ratio problem.

MIMO-Channel capacity-Spatial Multiplexing-Diversity- Beam forming- MIMO-OFDM-Wireless standards: GSM-WCDMA-LTE-IS 95-Wireless networks-Video over wireless.

Course outcomes

CO1: describe the Coherence time, Coherence frequency, Doppler spread and Delay spread

CO2: model the wireless channel using statistical approach

CO3: prepare the link budget for the wireless communication

CO4: describe various multiple access techniques and diversity techniques

CO5: compare various wireless standards

Textbooks

1. D. Tse and P.Viswanath, “Fundamentals of Wireless Communication”, Cambridge university press, 2005
2. A. Goldsmith, “Wireless Communications”, Cambridge University Press,2005
3. E.S.Gopi, “Digital signal processing for wireless communication using Matlab’’, Springer, 2016

Reference Books

1. T.S.Rappaport, “Wireless Communication Principles (2/e)”, Pearson,2002.
2. E. Biglieri, R.Calderbank, A. Constantinides, A. Goldsmith, A.Paulraj, H.Vincent poor, “MIMO Wireless Communications”, Cambridge University Press,2007.
3. Robert Gallager, Chapter 9: “Wireless communication”, course materials for 6.450 Principles of Digital communication I,Fall 2006.
4. MIT Open courseware http://ocw.mit.edu/.
5. A. K.Jagannatham,” Advanced 3G and 4G wireless mobile communications”-,IIT Kanpur, NPTEL Video lectures.http://nptel.iitm.ac.in

Course Code	**:**	**ECPE17**
Course Title	**:**	**Cognitive Radio**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC41**
Course Type	**:**	**PE**

Course learning Objectives

- introduces the fundamentals of multi rate signal processing and cognitive radio.

Course Content

Filter banks-uniform filter bank. direct and DFT approaches. Introduction to ADSL Modem. Discrete multitone modulation and its realization using DFT. QMF. STFT.Computation of DWT using filter banks.
DDFS- ROM LUT approach. Spurious signals, jitter. Computation of special functions using CORDIC. Vector and rotation mode of CORDIC.CORDIC architectures.

Block diagram of a software radio. Digital down converters and demodulators Universal modulator and demodulator using CORDIC. Incoherent demodulation - digital approach for I and Q generation, special sampling schemes. CIC filters. Residue number system and high speed filters using RNS. Down conversion using discrete Hilbert transform. Under sampling receivers, Coherent demodulation schemes.

Concept of Cognitive Radio, Benefits of Using SDR, Problems Faced by SDR, Cognitive Networks, Cognitive Radio Architecture. Cognitive Radio Design, Cognitive Engine Design,

A Basic OFDM System Model, OFDM based cognitive radio, Cognitive OFDM Systems, MIMO channel estimation, Multi-band OFDM, MIMO-OFDM synchronization and frequency offset estimation. Spectrum Sensing to detect Specific Primary System, Spectrum Sensing for Cognitive OFDMASystems.

Course outcomes

CO1: gain knowledge on multirate systems.
CO2: develop the ability to analyze, design, and implement any application using FPGA.
CO3: be aware of how signal processing concepts can be used for efficient FPGA based system design.
CO4: understand the rapid advances in Cognitive radio technologies.
CO5: explore DDFS, CORDIC and its application

Text Books

1. J. H. Reed, “Software Radio”, Pearson,2002.
2. U. Meyer – Baese , “Digital Signal Processing with FPGAs”, Springer,2004.
3. H. Arslan “Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems”, University of South Florida, USA, Springer,2007.

ReferenceBooks

1. S. K. Mitra, “Digital Signal processing”, McGrawHill,1998
2. K.C.Chen, R.Prasad , “Cognitive Radio Networks” , Wiley,2009-06-15.
3. T. W. Rondeau, C.W.Bostian, “Artificial Intelligence in Wireless Communications”, 2009.
4. T. DarcChiueh, P. Yun Tsai,” OFDM baseband receiver design for wireless communications”, Wiley,2007
5. Tusi, “Digital Techniques for Wideband receivers”, Artech House, 2001.

Course Code	**:**	**ECPE18**
Course Title	**:**	**Broadband Access Technologies**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC53 & ECPC61**
Course Type	**:**	**PE**

Course learning Objectives

- To impart fundamentals and latest technologies related to the design of broadband last mile-Access technologies for multimedia communication

Course Content

Wired access technologies using Phone line modem, ISDN modem. Comparison-Cable, DSL, fiber and wireless access technologies.

Last mile copper access, Flavors of Digital subscriber lines, DSL deployment, Common local loop impairments, discrete multitone modulation, VDSL deployment and frequency plans. Standards for XDSL and comparison.

Last mile HFC access, Cable modems. Modulation schemes, DOCSIS. Standards- comparison, physical and MAC layer protocols for HFC networks, ATM and IP-centric modem. Switched digital video.

Fiber access technologies and architectures. ATM passive optical networks, Upstream and downstream transport, Frame format, Ethernet passive optical network, Gigabit passive optical networks.

Survey on emerging broadband wireless access technologies. LMDS,MMDS,WIMAX and WIFI, Satellite technologies serving as last mile solutions, Wireless LAN, Wireless personal area networking, 3G and 4G wireless systems.

Course outcomes

CO1: recall and identify the basics of broadband technology systems and differentiate the differences between the various wired and wireless technology system

CO2: illustrate the aspects of last mile data transport on copper wire networks and flavors of DSL

CO3: summarize the versions of cable network standard and MAC protocols for HFC networks

CO4: distinguish the cost effective broadband services for residential users and ATM based and Ethernet based passive optical networks

CO5: outline the types of broadband wireless access technologies and their characteristics.

Text Books

1. N.Jayant, “Broadband last mile”-Taylor and Francisgroup,2005
2. N.Ransom& A.A. Azzam, “Broadband Access Technologies”, McGraw Hill,1999.
3. M.P. Clarke, “Wireless Access Network”, Wiley,2000.

Reference Books

1. T.Starr,M.Sorbara,J.M.Cioffi and P.J.Silverman,”DSLadvances”,PrenticeHall,2002
2. S. Mervana&C.Le, “Design and Implementation of DSL-based Access Solutions”, Cisco Press, 2001.
3. W. Vermillion, “End-to-End DSL Architecture”, Cisco Press,2003.
4. DOCSIS 2.0 “Radio frequency interface specification”www.cablemodem.com
5. ITU-T Rec., G.983.1 “Broadband Optical Access systems based on Passive OpticalNetworks”,1998.

Course Code	**:**	**ECPE19**
Course Title	**:**	**Satellite Communication**
Number of Credits		**3**
Prerequisites (Course code)	**:**	**ECPC61**
Course Type	**:**	**PE**

Course learning Objectives

- To introduce and to make understand the radio propagation channel for Earth station to satellite & satellite to Earth station.
- To introduce various aspects in the design of communication & multiple access systems for satellite communication.
- To introduce the concept of launchers and design of Earth station and satellite link.

Course Content

Elements of orbital mechanics. Equations of motion. Tracking and orbit determination. Orbital correction/control. Satellite launch systems. Multistage rocket launchers and their performance.

Elements of communication satellite design. Spacecraft subsystems. Reliability considerations. Spacecraft integration.

Multiple access techniques. FDMA,TDMA, CDMA. Random access techniques. Satellite onboard processing.

Satellite Link Design: Performance requirement and standards. VSAT, Mobile satellite services: GSM, GPS, DBS, DTH, MATV, CATV, Satellite based personal communication.
Earth station design. Configurations. Antenna and tracking systems. Satellite broadcasting. satellite navigation-recent advances.

Course outcomes

CO1: understand how analog and digital technologies are used for satellite communication networks.
CO2: To understand the radio frequency channel from earth station to satellite.
CO3: learn the dynamics of the satellite
CO4: learn the keplerian elements
CO5: study the design of Earth station and tracking of the satellites

Text books:

1. D.Roddy,"Satellite Communication (4/e)", McGraw-Hill, 2009.
2. T.Pratt&C.W.Bostain, "Satellite Communication", Wiley 2000.
3. Bruce R. Elbert, 'The Satellite Communication Applications' Hand Book, Artech HouseBostan London, 1997.

Reference Books:

1. B.N.Agrawal, "Design of Geosynchrons Spacecraft", Prentice-Hall,1986.
2. A.K. Maini, V.Agrawal, "Satellite Communications", Wiley India PvtLtd,1999.

Course Code	**:**	**ECPE20**
Course Title	**:**	**Microwave Integrated Circuit Design**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC42 & ECPC71**
Course Type	**:**	**PE**

Course learning Objectives

- To impart knowledge on basics of microwave electron beam devices and their applications in X band frequency**.**

Course Content

Design and realization of power dividers, hybrids, directional couplers etc using strip lines and microstrip lines.

Filter design; Kuroda identities. K and J inverters. Filter transformations. Realization using strip lines and micro strip lines.

Transistor amplifiers; Power gain equations. Stability considerations. Analysis. Design using MICs.

Transistor oscillators. Active devices for microwave oscillators. Three port S parameter characterization of transistors. Oscillation and stability conditions.

Diode mixers. Mixer design. Single ended mixer. Balanced mixer. Image rejection mixer. Phase shifter design. PIN diode. Phase shifter.

Course outcomes

CO1: the topics will make students design of the important and essential M.I.C. components

CO2: Filter is the most needed circuit for many applications and the unit will make the student confident in filter design

CO3: All aspects and different parameters, design factors and properties will me made thorough

CO4: One will be confident to handle any oscillator design

CO5: The student will become familiar and confident in the design of Mixers, the other essential circuits.

Text Books

1. I.J.Bahl&Bhartia, Micrwave Solid State Circuit Design, Wiley,1987.
2. G.D.Vendelin, Design of Amplifiers and Oscillators by the S Parameter Method, Wiley,1982.

Reference Books

1. T.C.Edwards, Foundations for MicrostripCircuir Design (2/e), Wiley,1992.

Course Code	**:**	**ECPC21**
Course Title	**:**	**Microwave Electronics**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC71**
Course Type	**:**	**PC**

Course Learning Objectives

- To impart knowledge on basics of microwave electron beam devices and their applications in X band frequency**.**

Course Content

Limitations of conventional vacuum tubes, Klystrons: Reentrant cavities, Two cavity klystron, Velocity modulation process, Bunching process ,Power output and efficiency; Multi-cavity klystron , Reflex klystron-Velocity modulation process, Mode Characteristics ,Electronic admittance spiral.

Travelling-wave tubes: Slow-wave structures, Helix TWT- Amplification process, Convection current, Wave modes and gain; Coupled cavity TWT, Backward wave oscillator.

Crossed -field devices: Magnetrons- Principle of operation, characteristics, Hull cut-off condition; Carcinotron, Gyrotron.

Microwave transistors and FETs: Microwave bipolar transistors-Physical structures, characteristics, Power-frequency limitations; Microwave tunnel diode, Microwave unipolar transistor – Physical structure, principle of operation, characteristics, High electron-mobility transistors.

Transferred electron and Avalanche transit-time devices: Gunn diode, Gunn diode as an oscillator. IMPATT, TRAPATT and BARITT.

Course outcomes

CO1: Apply the basic knowledge of waveguide and microwave resonator circuits.
CO2: Asses the methods used for generation and amplification of the microwave power.
CO3: Distinguish between the linear and cross field electron beam microwave tubes.
CO4: Critically analyze the operating principles and performances of the microwave semiconductor devices.
CO5: Identify the suitable microwave power sources of given specification for the selected application.
CO6: Aware of current technological changes in the engineering aspects of microwave components.

Text Book

1. S.Y.Liao, “Microwave Devices and Circuits (3/e)”, PHI, 2005.
2. R. F. Soohoo, “Microwave Electronics”, Wesley publication,1971.

Reference Books

1. R.E.Collin, “Foundations for Microwave Engineering (2/e)”,Wiley India, 2007.
2. D.M.Pozar,” Microwave Engineering (3/e)”, Wiley India, 2009.
3. K C Gupta, Indian Institute of Technology, Kanpur,” Microwaves”, Wiley Eastern Limited, 1995.

Course Code	**:**	**ECPE22**
Course Title	**:**	**Electronic Packaging**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**PE**

Course learning Objectives

- To introduce and discuss various issues related to the system packaging.

Course Content

Functions of an Electronic Package, Packaging Hierarchy, IC packaging: MEMS packaging, consumer electronics packaging, medical electronics packaging, Trends, Challenges, Driving Forces on Packaging Technology, Materials for Microelectronic packaging, Packaging Material Properties, Ceramics, Polymers, and Metals in Packaging, Material for high density interconnect substrates.

Electrical Anatomy of Systems Packaging, Signal Distribution, Power Distribution, Electromagnetic Interference, Design Process Electrical Design: Interconnect Capacitance, Resistance and Inductance fundamentals; Transmission Lines , Clock Distribution, Noise Sources, power Distribution, signal distribution, EMI, Digital and RF Issues. Processing Technologies, Thin Film deposition, Patterning, Metal to Metal joining.

IC Assembly – Purpose, Requirements, Technologies, Wire bonding, Tape Automated Bonding, Flip Chip, Wafer Level Packaging , reliability, wafer level burn – in and test. Single chip packaging : functions, types, materials processes, properties, characteristics, trends. Multi chip packaging : types, design, comparison, trends. Passives: discrete, integrated, embedded – encapsulation and sealing : fundamentals, requirements, materials, processes.

Printed Circuit Board: Anatomy, CAD tools for PCB design, Standard fabrication, Micro via Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges. Thermal Management, Heat transfer fundamentals, Thermal conductivity and resistance, Conduction, convection and radiation – Cooling requirements.

Reliability, Basic concepts, Environmental interactions. Thermal mismatch and fatigue – failures – thermo mechanically induced – electrically induced – chemically induced. Electrical Testing: System level electrical testing, Interconnection tests, Active Circuit Testing, Design for Testability.

Course outcomes

CO1: describe the functions and applications of packages and materials used for packaging.
CO2: explain the procedure used for evaluating the electrical aspects of packaging including delay, cross talk
CO3: apply the design technique and analyse the electrical characteristics of VLSI circuits.
CO4: describe about the single chip and multi chip packages and techniques.
CO5: explain the techniques for bonding the packages todies.
CO6: explain the technique used for fabrication and characteristics of single layer and multi layer PCBs and compare their performances.
CO7: describe about thermal management techniques for packages and reliability of packages.

Text Book

1. Tummala, Rao R., “Fundamentals of Microsystems Packaging”, McGraw Hill,2001.

Reference Books

1. Blackwell (Ed), “The electronic packaging handbook”, CRCPress,2000.
2. Tummala, Rao R, “Microelectronics packaging handbook”, McGraw Hill,1963.
3. Bosshart, “Printed Circuit Boards Design and Technology”,TataMcGrawHill,1983.
4. R.G. Kaduskar and V.B.Baru, “Electronic Product design”, Wiley India,2011.
5. R.S.Khandpur, “Printed Circuit Board”, Tata McGraw Hill,2005.

OPEN ELECTIVES

Course Code	**:**	**ECOE 11**
Course Title	**:**	**Computer Architecture and Organization**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**OE**

Course learning Objectives

- To understand how computers are constructed out of a set of functional units and how the functional units operate, interact, and communicate.
- To make the students to understand the concept of interfacing memory and various I/O devices to a computer system using a suitable bus system.

Course Content

Introduction: Function and structure of a computer, Functional components of a Computer, Interconnection of components, Performance of a computer.

Representation of Instructions: Machine instructions, Memory locations & Addresses, Operands, Addressing modes, Instruction formats, Instruction sets, Instruction set architectures - CISC and RISC architectures, Super scalar Architectures, Fixed point and floating point operations.

Basic Processing Unit: Fundamental concepts, ALU, Control unit, Multiple bus organization, Hardwired control, Micro programmed control, Pipelining, Data hazards, Instruction hazards, Influence on instruction sets, Data path and control considerations, Performance considerations.

Memory organization: Basic concepts, Semiconductor RAM memories, ROM, Speed - Size and cost, Memory Interfacing circuits, Cache memory, Improving cache performance, Memory management unit, Shared/Distributed Memory, Cache coherency in multiprocessor, Segmentation, Paging, Concept of virtual memory, Address translation, Secondary storage devices.

I/O Organization: Accessing I/O devices, Input/output programming, Interrupts, Exception Handling, DMA, Buses, I/O interfaces- Serial port, Parallel port, PCI bus, SCSI bus, USB bus, Firewall and Infini band, I/O peripherals.

Course outcomes

CO1: apply the basic knowledge of digital concept to the functional components of a Computer System.
CO2: analyze the addressing mode concepts and design the instruction set Architecture.
CO3: identify the functions of various processing units within the CPU of a Computer System.
CO4: analyze the function of the memory management unit and create suitable memory interface to the CPU.
CO5: recognize the need for recent Bus standards and I/O devices.

Text Books

1. *C.Hamacher Z. Vranesic and S. Zaky, "Computer Organization", McGraw-Hill,2002.*
2. *W. Stallings, "Computer Organization and Architecture - Designing for Performance", Prentice Hall of India,2002.*
3. *B,Parhami, "Computer Architecture, From Microprocessors to Supercomputers," Oxford University Press, Reprint2014.*

Reference Books

1. *D. A. Patterson and J. L. Hennessy, "Computer Organization and Design,*
2. *Morgan Kaufmann," The Hardware/Software Interface",1998.*
3. *J .P. Hayes, "Computer Architecture and Organization", McGraw-Hill,1998.*

Course Code	**:**	**ECOE12**
Course Title	**:**	**Multimedia Communication Technology**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**OE**

Course learning Objectives

- To made the students to understand various encoding and decoding techniques of audios and videos in multimedia systems.

Course content

Components of multimedia system, Desirable features, Applications of multimedia systems, Introduction to different types, Multimedia storage device.

Digital audio representation and processing-time domain and transform domain representations. Coding standards, transmission and processing of digital audio. Musical instrument synthesizers.

Still image coding-JPEG. Discrete cosine Transform. Sequential and Progressive DCT based encoding algorithms, lossless coding, hierarchical coding. Basic concepts of discrete wavelet transform coding and embedded image coding algorithms. Introduction to JPEG2000.

Feature of MPEG 1, structure of encoding and decoding process, MPEG 2 enhancements, different blocks of MPEG video encoder.

Content based video coding-overview of MPEG 4 video, motion estimation and compensation. Different coding techniques and verification models. Block diagram of MPEG 4 video encoder and decoder. An overview of H261 and H263 video coding techniques.

Course outcomes

CO1: analyze various components of the multimedia systems and its storage devices.
CO2: appreciate the different coding standards for the digital audio and musical synthesizers.
CO3: understand the various types of DCT based image encoding algorithms
CO4: understand the encoding and decoding process of the MPEG standards
CO5: analyse the different content based video processing techniques.

Text Books

1. Y.Q.Shi&H.Sun, Image and Video Compression for Multimedia Engineering, CRC Press,2000.
2. S.V.Raghavan & S,K,Tripathi, Networked Multimedia Systems, Prentice-Hall,1998.

Reference Books

1. J.F.K.Buford, Multimedia Systems, Pearson,2000.

Course Code	**:**	**ECOE13**
Course Title	**:**	**ARM System Architecture**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**OE**

Course learning Objectives

- The objective of this course is to give the students a thorough exposure to ARM architecture and make the students to learn the ARM programming & Thumb programming models.

Course content

RISC machine. ARM programmer's model. ARM Instruction Set. Assembly level language programming. Development tools.

ARM organization.ARM instruction execution.ARM implementation. ARM coprocessor interface. . Interrupt response.

Floating point architecture. Expressions. Conditional statements. Loops. Functions and procedures. Run time environment.

Thumb programmer's model. Thumb Instruction set. Thumb implementation.

Memory hierarchy. Architectural support for operating system. Memory size and speed. Cache memory management. Operating system. ARM processor chips.

Course outcomes

CO1: describe the programmer's model of ARM processor and create and test assembly level programming.
CO2: analyze various types of coprocessors and design suitable co-processor interface to ARM processor.
CO3: analyze floating point processor architecture and its architectural support for higher level language.
CO4: become aware of the Thumb mode of operation of ARM.
CO5: identify the architectural support of ARM for operating system and analyze the function of memory Management unit of ARM.

Text Books

1. S. Furber, "ARM System Architecture",Addison-Wesley,1996.
2. A. Sloss, D.Symes& C.Wright, "ARM system Developer's guide",Elsevier.2005.

Reference Books

1. Technical reference manual for ARM processor cores, including Cortex, ARM 11, ARM 9 & ARM 7 processor families.
2. User guides and reference manuals for ARM software development and modeling tools. David Seal, ARM Architecture Reference Manual, Addison-Wesley.

Course Code	**:**	**ECOE14**
Course Title	**:**	**Networks and Protocols**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**OE**

Course Learning Objectives

- To get an understanding on the fundamentals of networks and issues involved.
- To acquire an understanding on the set of rules and procedures that mediates the exchange of information between communicating devices.

Course Content

Network Components, Topologies, Network hardware and software, Network Models: OSI Model & TCP/IP Protocol stack, HTTP FTP, SMTP, POP, SNMP, DNS, Socket programming with TCP and UDP.

Transport Layer services, UDP, TCP, SCTP, Principles of reliable data transfer, Flow control, Congestion Control, Quality of Service.

Network Layer services, Datagram and Virtual circuit service, DHCP, IPV4, IPV6, ICMP, Unicast routing protocols: DV, LS and Path vector routing, Multicast routing.

Data Link Layer services, Overview of Circuit and Packet switches, ARP, Data link control: HDLC & PPP, Multiple access protocols, Wireless LAN, Comparison wired and wireless LAN.

Network security threats, Cryptography, Security in the Internet: IPSecurity & Firewalls, Multimedia: Streaming stored video/ audio, RTP, Network Troubleshooting.

Course outcomes

CO1: Compare and examine, OSI and TCP/IP protocol stacks
CO2: Categorize services offered by all layers in TCP/IP protocol stack
CO3: Analyze a network under congestion and propose solutions for reliable data transfer
CO4: Examine the protocols operating at different layers of TCP/IP model
CO5: Assess the cryptographic techniques.
CO6: Manage a network and propose solutions under network security threats.

Text Books

1. J.F.Kurose&K.W.Ross, "Computer Networking: A Top-Down Approach featuring the Internet", Pearson, 5th edition, 2010.
2. B.A. Forouzan," Data Communications & Networking", Tata McGraw- Hill, 4th edition, 2006

Reference Books

1. W.Stallings, "Data & Computer Communications", PHI, 9th edition, 2011.
2. W.Stallings, "Cryptography & Network Security", Pearson, 5th edition, 2011.
3. A.S.Tanenbaum & D.J. Wetherall, "Computer Networks", Pearson, 5th edition, 2014.

Course Code	**:**	**ECOE15**
Course Title	**:**	**Ad hoc Wireless Networks**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**OE**

Course learning Objectives

- To analyse the various design issues and challenges in the layered architecture of Ad hoc wireless networks

Course Content

Cellular and ad hoc wireless networks, Applications of ad hoc wireless networks. Issues in ad hoc wireless networks-medium access scheme, routing, transport layer protocols, security and energy management. Ad hoc wireless internet.

Design goals of a MAC protocol, Contention based protocols; Contention based protocols with reservation mechanisms and scheduling mechanisms, MAC protocols using directional antennas.

Table driven routing protocols, On demand routing protocols, hybrid routing protocols, Hierarchical routing protocols, Power aware routing protocols, Tree based and mesh based multicast routingprotocols

Network security requirements-Issues and challenges, network security attacks, key management, secure routingprotocols

Energy management schemes-Battery management,transmission power management, system power management schemes. Quality of service solutions in ad hoc wireless networks.

Course outcomes

CO1: compare the differences between cellular and ad hoc networks and the analyse the challenges at various layers and applications

CO2: summarize the protocols used at the MAC layer and scheduling mechanisms

CO3: compare and analyze types of routing protocols used for unicast and multicast routing

CO4: examine the network security solution and routing mechanism

CO5: evaluate the energy management schemes and Quality of service solution in ad hoc networks

Text books

1. *C.Siva ram murthy,B.S. Manoj, "Ad hoc wireless networks-Architectures and protocols" Pearson Education, 2005*
2. *S.Basagni, M.Conti, "Mobile ad hoc networking", Wielyinterscience2004*
3. *C. E.Perkins ,"Ad hoc networking", AddisonWesley,2001*

Reference books

1. *X.Cheng, X.Huang ,D.Z. DU ,"Ad hoc wireless networking", Kluwer AcademicPublishers,2004*
2. *G. Aggelou,"Mobile ad hoc networks-From wireless LANs to 4G networks", McGraw Hill publishers,2005*

Course Code	**:**	**ECOE16**
Course Title	**:**	**Digital Image Processing**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**OE**

Course learning Objectives

- To treat the 2D systems as an extension of 1D system design and discuss techniques specific to 2D systems.

Course Content

Linearity and space-invariance. PSF, Discrete images and image transforms, 2-D sampling and reconstruction, Image quantization, 2-D transforms and properties.

Image enhancement- Histogram modelling, equalization and modification. Image smoothing, Image crispening. Spatial filtering, Replication and zooming, Generalized cepstrum and homomorphic filtering.

Image restoration- image observation models.Inverse and Wiener filtering. Filtering using image transforms. Constrained least-squares restoration. Generalized inverse, SVD and interactive methods. Recursive filtering. Maximum entropy restoration. Bayesian methods.

Image data compression- sub sampling, Coarse quantization and frame repetition. Pixel coding - PCM, entropy coding, runlength coding Bit-plane coding. Predictive coding. Transform coding of images. Hybrid coding and vector DPCM. Interframe hybrid coding.

Image analysis- applications, Spatial and transform features. Edge detection, boundary extraction, AR models and region representation. Moments as features. Image structure.Morphological operations and transforms.Texture.Scene matching and detection. Segmentation and classification.

Course outcomes

CO1: analyze the need for image transforms, types and their properties.

CO2: become skilled at different techniques employed for the enhancement of images both in spatial and frequency domain.

CO3: explore causes for image degradation and to teach various restoration techniques.

CO4: evaluate the image compression techniques in spatial and frequency domain.

CO5: gain knowledge of feature extraction techniques for image analysis and recognition.

Text Books

1. A.K. Jain, “ Fundamentals of Digital Image Processing” , PHI,1995.
2. R.C.Gonzalez& R.E. Woods,” Digital Image Processing”, (2/e),Pearson,2002.

Reference Books

1. J.C. Russ, “The Image Processing Handbook”, (5/e), CRC,2006.
2. E.S.Gopi,"Digital Image processing using Matlab", Scitechpublications,2006.

Course Code	**:**	**ECOE17**
Course Title	**:**	**Wireless Sensor Networks**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**OE**

Course learning Objectives

- To overview the various design issues and challenges in the layered architecture of Wireless sensor networks

Course Content

Motivation for a network of wireless sensor nodes-Definitions and background-challenges and constraints for wireless sensor networks-Applications. Node architecture-sensing subsystems, processing Subsystems, Communication interfaces, Prototypes.

Physical layer- Introduction, wireless channel and communication fundamentals – frequency allocation, modulation and demodulation, wave propagation effects and noise, channels models, spread spectrum communication, packet transmission and synchronization, quality of wireless channels and measures for improvement, physical layer and transceiver design consideration in wireless sensor networks, Energy usage profile, choice of modulation, PowerManagement

Data link layer- Fundamentals of wireless MAC protocols, Characteristics of MAC protocol in wireless sensor networks contention-based protocols, Contention free MAC protocols,HybridMACprotocols

Network layer-routing metrics-Flooding and gossiping, Data centric routing, proactive routing On demand routing, hierarchical routing, Location based routing, QOS based routing. Data Aggregation – Various aggregationtechniques.

Case study-Target detection tracking, Habitat monitoring, Environmental disaster monitoring, Practical implementation issues, IEEE 802.15.4 low rate WPAN, Operating System Design Issues. Simulationtools.

Course outcomes

CO1: analyze the challenges and constraints of wireless sensor network and its subsystems
CO2: examine the physical layer specification, modulation and transceiver design considerations
CO3: analyze the protocols used at the MAC layer and scheduling mechanisms
CO4: compare and analyse the types of routing protocols and data aggregation techniques
CO5: identify the application areas and practical implementation issues.

Text books

1. W. Dargie,C. Poellabauer,"Fundamentals of Wireless sensor networks-Theory and Practice",John Wiley & Sons Publication2010
2. K. Sohraby, D.Minoli and T.Znati, "Wireless Sensor Network Technology- Protocols and Applications", John Wiley & Sons,2007.
3. F.Zhao, L.Guibas, "Wireless Sensor Networks: an information processing approach", Elsevier publication,2004.
4. C.S.Raghavendra Krishna,M.Sivalingam and Taribznati, "Wireless Sensor Networks", Springer publication,2004.

5. H. Karl, A.willig, “Protocol and Architecture for Wireless Sensor Networks”, John Wiley publication, Jan2006.

Reference Books

1. K.Akkaya and M.Younis, “ A Survey of routing protocols in wireless sensor networks”, Elsevier Adhoc Network Journal, Vol.3, no.3,pp. 325-349,2005.
2. Philip Levis, “ TinyOS Programming”, 2006 –www.tinyos.net.
3. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, “Wireless sensor networks: a survey”, computer networks, Elsevier, 2002, 394 -422.
4. Jamal N. Al-karaki, Ahmed E. Kamal, “Routing Techniques in Wireless sensor networks: A survey”, IEEE wireless communication, December 2004, 6 –28.

Course Code	**:**	**ECOE18**
Course Title	**:**	**Digital Speech Processing**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**OE**

Course learning Objectives

- The purpose of this course is to explain how DSP techniques could be used for solving problems in speech communication.

Course Content

Speech production model-1D sound waves-functional block of the Vocal tract model –Linear predictive co- efficients (LPC) -Auto-correlation method-Levinson-durbin algorithm-Auto-co-variance method-Lattice structure-Computation of Lattice co-efficient from LPC-Phonetic Representation of speech-Perception of Loudness - Critical bands – Pitch perception – Auditory masking.

Feature extraction of the speech signal: Endpoint detection-Dynamic time warping- Pitch frequency estimation: Autocorrelation approach- Homomorphic approach-Formant frequency estimation using vocal tract model and Homomorphic approach-Linear predictive co-efficient - Poles of the vocal tract-Reflection co-efficient-Log Areararatio.

Cepstrum- Line spectral frequencies- Functional blocks of the ear- Mel frequency cepstral co-efficients- Spectrogram-Time resolution versus frequency resolution-Discrete wavelet transformation.

Pattern recognition for speech detection: Back-propagation Neural Network-Support Vector Machine- Hidden Markov Model (HMM)-Gaussian Mixture Model(GMM) -Unsupervised Learning system: K-Means and Fuzzy K-means clustering - Kohonen self-organizing map-Dimensionality reduction techniques: Principle component analysis (PCA), Linear discriminant analysis (LDA), Kernel-LDA (KLDA), Independent component analysis(ICA).

Non-uniform quantization for Gaussian distributed data- Adaptive quantization-Differential pulse code modulation- Code Exited Linear prediction (CELP)-Quality assessment of the compressed speech signal Text to Speech (TTS) analysis –Evolution of speech synthesis systems-Unit selection methods - TTS Applications.

Course outcomes

CO1: illustrate how the speech production is modeled

CO2: summarize the various techniques involved in collecting the features from the speech signal in both time and frequency domain

CO3: summarize the functional blocks of the ear

CO4: compare the various pattern recognition techniques involved in speech and speaker detection

CO5: summarize the various speech compression techniques

Text Books

1. L.R.Rabiner and R.W.Schafer,” Introduction to Digital speech processing”,now publishers USA,2007
2. E.S.Gopi,”Digital speech processing using matlab”,Springer,2014.

Reference Books

1. L.R.Rabiner and R.W.Schafer,"Digital processing of speech signals", PrenticeHall,1978
2. T.F.Quatieri,"Discrete-time Speech Signal Processing", Prentice-Hall, PTR,2001
3. L.Hanzaetal, "Voice Compression and Communications", Wiley/ IEEE ,2001.

Course Code	**:**	**ECOE19**
Course Title	**:**	**Pattern Recognition**
Number of Credits		**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**OE**

Course learning Objectives

- The subject aims to make the students to understand the mathematical approach for pattern recognition.

Course Content

Polynomial curve fitting – The curse of dimensionality - Decision theory - Information theory - The beta distribution - Dirichlet distribution-Gaussian distribution-The exponent family: Maximum likelihood and sufficient statistics -Non-parametric method: kernel-density estimators - Nearest neighbor methods.

Linear models for regression and classification: Linear basis function models for regression - Bias variance decomposition-Bayesian linear regression-Discriminant functions - Fisher's linear discriminant analysis (LDA) - Principal Component Analysis (PCA) - Probabilistic generative model - Probabilistic discriminative model.

Kernel methods: Dual representations-Constructing kernels-Radial basis function networks-Gaussian process-Maximum margin classifier (Support Vector Machine) –Relevance Vector Machines-Kernel-PCA, Kernel-LDA.

Mixture models: K-means clustering - Mixtures of Gaussian - Expectation-Maximization algorithm- Sequential models: Markov model, Hidden-Markov Model (HMM) - Linear Dynamical Systems(LDS).

Neural networks: Feed- forward Network functions-Network training - Error Back propagation - The Hessian Matrix - Regularization in Neural Network - Mixture density networks – Bayesian Neural Networks

Course outcomes

CO1: summarize the various techniques involved in pattern recognition
CO2: identify the suitable pattern recognition techniques for the particular applications.
CO3: categorize the various pattern recognition techniques into supervised and unsupervised.
CO4: summarize the mixture models based pattern recognition techniques
CO5: summarize the artificial neural network based pattern recognition techniques

Text Books

1. C.M.Bishop,"Pattern recognition and machinelearning",Springer,2006
2. J.I.Tou&R.C.Gonzalez," Pattern Recognition Priciples", Addition –Wesley,1977.

Reference Books

1. P.A.Devijer&J.Kittler, "Pattern Recognition-A Statistical Approach" , Prentice – Hall,1990.
2. R.Schalkoff, "Pattern Recognition –Statistical, Structural and Neural Approaches", John Wiley, 1992.

Minors Offered

Course Code	**:**	**ECMI11**
Course Title	**:**	**Signals and Systems**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**MI**

Course Learning Objectives

- Understanding the fundamental characteristics of signals and systems.
- Understanding the concepts of vector space, inner product space and orthogonal series.
- Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
- Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

Course Content

Vector spaces. Inner Product spaces. Schwartz in equality. Hilbert spaces. Orthogonal expansions. Bessel's inequality and Parseval's relations.
Continuous-time signals, classifications. Periodic signals. Fourier series representation, Hilbert transform and its properties.
Laplace transforms. Continuous - time systems: LTI system analysis using Laplace and Fourier transforms.
Sampling and reconstruction of band limited signals. Low pass and band pass sampling theorems. Aliasing. Anti-aliasing filter. Practical Sampling-aperture effect.
Discrete-time signals and systems. Z-transform and its properties. Analysis of LSI systems using Z – transform.

Course outcomes

CO1: apply the knowledge of linear algebra topics like vector space, basis, dimension, inner product, norm and orthogonal basis to signals.
CO2: analyse the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis.
CO3: classify systems based on their properties and determine the response of LSI system using convolution.
CO4: analyze system properties based on impulse response and Fourier analysis.
CO5: apply the Laplace transform and Z- transform for analyze of continuous-time and discrete-time signals and systems.
CO6: understand the process of sampling and the effects of under sampling.

Text Books

1. *A.V.Oppenheim, A. Willsky, S. Hamid Nawab, "Signals and Systems (2/e)", Pearson 200.*
2. *S.Haykin and B.VanVeen "Signals and Systems, Wiley, 1998.*
3. *M.Mandal and A.Asif, "Continuous and Discrete Time Signals and Systems, Cambridge, 2007.*

Reference Books

1. *D.C.Lay, "Linear Algebra and its Applications (2/e)", Pearson, 200.*
2. *K.Huffman&R.Kunz, "Linear Algebra", Prentice*- Hall, *1971*.
3. *S.S.Soliman&M.D.Srinath, "Continuous and Discrete Signals and Systems", Prentice-Hall, 1990.*

Course Code	**:**	**ECMI12**
Course Title	**:**	**Network Analysis and Synthesis**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**MI**

Course Learning Objectives

- To make the students capable of analyzing any given electrical network.
- To make the students to learn synthesis of an electrical network for a given impedance/ admittance function.

Course Content

Network concept. Elements and sources. Kirchoff's laws. Tellegen's theorem. Network equilibrium equations. Node and Mesh method. Source superposition. Thevenin's and Norton's theorems. Network graphs.

First and second order networks. State equations. Transient response. Network functions. Determination of the natural frequencies and mode vectors from network functions.

Sinusoidal steady-state analysis. Maximum power-transfer theorem. Resonance. Equivalent and dual networks. Design of equalizers.

Two-port network parameters. Interconnection of two port networks. Barlett's bisection theorem. Image and Iterative parameters. Design of attenuators.

Two-terminal network synthesis. Properties of Hurwitz polynomial and Positive real function. Synthesis of LC, RC and RL Networks, Foster Forms and Cauer Forms.

Course outcomes

CO1: analyze the electric circuit using network theorems

CO2: understand and Obtain Transient & Forced response

CO3: determine Sinusoidal steady state response; understand the real time applications of maximum power transfer theorem and equalizer

CO4: understand the two–port network parameters, are able to find out two-port network parameters & overall response for interconnection of two-port networks.

CO5: synthesize one port network using Foster form, Cauer form.

Text Books

1. *Hayt W. H., Kemmerly J. E. and Durbin S. M., "Engineering Circuit Analysis", 6th Ed., Tata McGraw-Hill Publishing Company Ltd., 2008.*
2. *F.F. Kuo, "Network analysis and Synthesis", Wiley International Edition, 2008.*

Reference Books

1. *Valkenberg V., "Network Analysis", 3rd Ed., Prentice Hall International Edition, 2007.*
2. *B.S.Nair and S.R.Deepa, "Network analysis and Synthesis", Elsevier, 2012.*

Course Code	**:**	**ECMI13**
Course Title	**:**	**Electrodynamics and Electromagnetic Waves**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**MI**

Course Learning Objective

- To expose the students to the rudiments of Electromagnetic theory and wave propagation essential for subsequent courses on microwave engineering, antennas and wireless communication

Course Content

Electrostatics. Coulomb's law. Gauss's law and applications. Electric potential. Poisson's and Laplace equations. Method of images. Multipole Expansion.

Electrostatic fields in matter. Dielectrics and electric polarization. Capacitors with dielectric substrates. Linear dielectrics. Force and energy in dielectric systems.

Magneto statics. Magnetic fields of steady currents. Biot-Savart's and Ampere's laws. Magnetic vector potential. Magnetic properties of matter.

Electrodynamics. Flux rule for motional emf. Faraday's law. Self and mutual inductances. Maxwell's Equations. Electromagnetic Boundary conditions. Poynting theorem.

Electromagnetic wave propagation. Uniform plane waves. Wave polarization. Waves in matter. Reflection and transmission at boundaries. Propagation in an ionized medium.

Course outcomes

CO1: recognize and classify the basic Electrostatic theorems and laws and to derive them.
CO2: discuss the behaviour of Electric fields in matter and Polarization concepts.
CO3: classify the basic Magneto static theorems and laws and infer the magnetic properties of matter.
CO4: summarize the concepts of electrodynamics &to derive and discuss the Maxwell's equations.
CO5: students are expected to be familiar with Electromagnetic wave propagation and wave polarization.

Text Books

1. *D.J.Griffiths, "Introduction to Electrodynamics (3/e)", PHI, 2001*
2. *E.C. Jordan & G. Balmain, "Electromagnetic Waves and Radiating Systems", PHI, 1995.*

Reference Books

1. *W.H.Hayt, "Engineering Electromagnetics, (7/e)", McGraw Hill, 2006.*
2. *D.K.Cheng, "Field and Wave Electromagnetics, (2/e)", Addison Wesley, 1999.*
3. *M.N.O.Sadiku,"Principles of Electromagnetics, (4/e)", Oxford University Press, 2011.*
4. *N.NarayanaRao, "Elements of Engineering Electromagnetics, (6/e)", Pearson, 2006.*
5. *R.E.Collin, "Foundations for Microwave Engineering (2/e)", McGraw –Hill, 2002.*
6. *R.E.Collin, "Antennas and Radiowave Propagation", McGraw-Hill, 1985.*

Course Code	**:**	**ECMI14**
Course Title	**:**	**Semiconductor Physics and Devices**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**MI**

Course Learning Objective

- To make the students understand the fundamentals of electronic devices.
- To train them to apply these devices in mostly used and important applications.

Course Content

Semiconductor materials: crystal growth, film formation, lithography, etching and doping. Formation of energy bands in solids, Concept of hole, Intrinsic and extrinsic semiconductors, conductivity, Equilibrium Carrier concentration, Density of states and Fermi level, Carrier transport – Drift and Diffusion, continuity equation, Hall effect and its applications.

P-N junction diodes, Energy band diagram, biasing, V-I characteristics, capacitances. Diode models, Break down Mechanisms, Rectifiers, Limiting and Clamping Circuits, types of diodes.

BJT Physics and Characteristics modes of operation, Ebers-Moll Model, BJT as a switch and Amplifier, breakdown mechanisms, Photo devices.

MOSFET: Ideal I-V characteristics, non-ideal I-V effects, MOS Capacitor, MOSFET as switch, CMOS Logic gate Circuits, Bi-CMOS circuits, CCDs.

Power devices, operation and characteristics. Thyristor family. Power diodes. Power transistors. Display devices, Operation of LCDs, Plasma, LED and HDTV

Course outcomes

CO1: Apply the knowledge of basic semiconductor material physics and understand fabrication processes.
CO2: Analyze the characteristics of various electronic devices like diode, transistor etc.,
CO3: Classify and analyze the various circuit configurations of Transistor and MOSFETs.
CO4: Illustrate the qualitative knowledge of Power electronic Devices.
CO5: Become Aware of the latest technological changes in Display Devices.

Text Books

1. *S.M.Sze, Semiconductors Devices, Physics and Technology, (2/e), Wiley, 2002*
2. *A.S.Sedra&K.C.Smith, Microelectronic Circuits (5/e), Oxford, 2004*
3. *L.Macdonald&A.C.Lowe, Display Systems, Wiley, 2003*

Reference Books

1. *Robert Pierret, "Semiconductor Device Fundamentals," Pearson Education, 2006*
2. *J.Millman and C.C.Halkias: Electronic devices and Circuits, McGraw Hill, 1976.*
3. *B.G.Streetman: Solid state devices, (4/e), PHI, 1995.*
4. *N.H.E.Weste, D. Harris, "CMOS VLSI Design (3/e)", Pearson, 2005.*

Course Code	**:**	**ECMI15**
Course Title	**:**	**Digital Circuits and Systems**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**MI**

Course Learning Objective

- To introduce the theoretical and circuit aspects of digital electronics, which is the back bone for the basics of the hardware aspect of digital computers?

Course Content

Review of number systems-representation-conversions, error detection and error correction. Review of Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms-minterm and maxterm, Simplification of Boolean expressions- Karnaugh map, completely and incompletely specified functions, Implementation of Boolean expressions using universal gates.

Combinational logic circuits- adders, subtractors, BCD adder, ripple carry look ahead adders, parity generator, decoders, encoders, multiplexers, demultiplexers, Realization of Boolean expressions- using decoders-using multiplexers. Memories – ROM- organization, expansion. PROMs. Types of RAMs – Basic structure, organization, Static and dynamic RAMs, PLDs, PLAs.

Sequential circuits – latches, flip flops, edge triggering, asynchronous inputs. Shift registers, Universal shift register, applications. Binary counters – Synchronous and asynchronous up/down counters, mod-N counter, Counters for random sequence.

Synchronous circuit analysis and design: structure and operation, analysis-transition equations, state tables and state diagrams, Modelling- Moore machine and Mealy machine- serial binary adder, sequence recogniser, state table reduction, state assignment. Hazard; Overview and comparison of logic families.

Introduction to Verilog HDL, Structural, Dataflow and behavioral modelling of combinational and sequential logic circuits.

Course outcomes

CO1: Apply the knowledge of Boolean algebra and simplification of Boolean expressions to deduce optimal digital networks.

CO2: Study and examine the SSI, MSI and Programmable combinational networks.

CO3: Study and investigate the sequential networks suing counters and shift registers; summarize the performance of logic families with respect to their speed, power consumption, number of ICs and cost.

CO4: Work out SSI and MSI digital networks given a state diagram based on Mealy and Moore configurations.

CO5: Code combinational and sequential networks using Virology HDL.

Text Books

1. *Wakerly J F, "Digital Design: Principles and Practices, Prentice-Hall", 2nd Ed., 2002.*
2. *D. D. Givone, "Digital Principles and Design", Tata Mc-Graw Hill, New Delhi, 2003.*
3. *S.Brown and Z.Vranesic, "Fundamentals of Digital Logic with Verilog Design", Tata Mc-Graw Hill, 2008.*

Reference Books

1. *D.P. Leach, A. P. Malvino, GoutamGuha, "Digital Principles and Applications", Tata Mc-Graw Hill, New Delhi, 2011.*
2. *M. M. Mano, "Digital Design", 3rd ed., Pearson Education, Delhi, 2003.*
3. *R.J.Tocci and N.S.Widner, "Digital Systems - Principles& Applications", PHI, 10th Ed., 2007.*
4. *Roth C.H., "Fundamentals of Logic Design", Jaico Publishers. V Ed., 2009.*
5. *T. L. Floyd and Jain,"Digital Fundamentals", 8th ed., Pearson Education, 2003.*

Course Code	**:**	**ECMI16**
Course Title	**:**	**Digital Signal Processing**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECMI11**
Course Type	**:**	**MI**

Course Learning Objective

- The subject aims to introduce the mathematical approach to manipulate discrete time signals, which are useful to learn digital tele-communication.

Course Content

Review of VLSI system theory, DTFT, Frequency response of discrete time systems, all pass inverse and minimum phase systems.
DFT, Relationship of DFT to other transforms, FFT, DIT and DIF, FFT algorithm, Linear filtering using DFT and FFT.
Frequency response of FIR filter types, Design of FIR filters, IIR filter design, Mapping formulas, Frequency transformations.
Direct form realization of FIR and IIR systems, Lattice structure for FIR and IIR systems, Finite-word length effects. Limit cycle oscillations.
Sampling rate conversion by an integer and rational factor, Poly phase FIR structures for sampling rate conversion.

Course outcomes

CO1: analyze discrete-time systems in both time & transform domain and also through pole-zero placement.
CO2: analyze discrete-time signals and systems using DFT and FFT.
CO3: design and implement digital finite impulse response (FIR) filters.
CO4: design and implement digital infinite impulse response (IIR) filters.
CO5: understand and develop multirate digital signal processing systems.

Text Books

1. *J.G.Proakis, D.G. Manolakis, "Digital Signal Processing", (4/e) Pearson, 2007.*
2. *A.V.Oppenheim & R.W.Schafer, "Discrete Time Signal processing", (2/e), Pearson Education, 2003.*
3. *S.K.Mitra, "Digital Signal Processing (3/e)", Tata McGraw Hill, 2006.*

Reference Books

1. *P.S.R .Diniz, E.A.B.da Silva and S.L.Netto, "Digital Signal Processing", Cambridge, 2002.*
2. *E.C.Ifeachor & B.W.Jervis, "Digital Signal Processing", (2/e), Pearson Education, 2002.*
3. *J.R.Jhonson, "Introduction to Digital Signal Processing", Prentice-Hall, 1989.*

Course Code	**:**	**ECMI17**
Course Title	**:**	**Analog Communication**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECMI11**
Course Type	**:**	**MI**

Course Learning Objective

- To develop a fundamental understanding on Communication Systems with emphasis on analog modulation techniques and noise performance.

Course Content

Basic blocks of Communication System. Amplitude (Linear) Modulation – AM, DSB-SC, SSB-SC and VSB-SC. Methods of generation and detection. FDM. Super Heterodyne Receivers.
Angle (Non-Linear) Modulation - Frequency and Phase modulation. Transmission Bandwidth of FM signals, Methods of generation and detection. FM Stereo Multiplexing.
Noise - Internal and External Noise, Noise Calculation, Noise Figure. Noise in linear and nonlinear AM receivers, Threshold effect.
Noise in FM receivers, Threshold effect, Capture effect, FM Threshold reduction, Pre-emphasis and De-emphasis.
Pulse Modulation techniques – Sampling Process, PAM, PWM and PPM concepts, Methods of generation and detection. TDM. Noise performance.

Course outcomes

CO1: Understand the basics of communication system and analog modulation techniques
CO2: Apply the basic knowledge of signals and systems and understand the concept of Frequency modulation.
CO3: Apply the basic knowledge of electronic circuits and understand the effect of Noise in communication system and noise performance of AM system
CO4: Understand the effect of noise performance of FM system.
CO5: Understand TDM and Pulse Modulation techniques.

Text Books

1. *S.Haykins, Communication Systems, Wiley, (4/e), Reprint 2009.*
2. *Kennedy, Davis, Electronic Communication Systems (4/e), McGraw Hill, Reprint 2008.*

Reference Books

1. *B.Carlson, Introduction to Communication Systems, McGraw-Hill, (4/e), 2009.*
2. *J.Smith, Modern Communication Circuits (2/e), McGraw Hill, 1997.*
3. *J.S.Beasley&G.M.Miler, Modern Electronic Communication (9/e), Prentice-Hall, 2008.*

Course Code	**:**	**ECMI18**
Course Title	**:**	**Digital Communication**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECMI17**
Course Type	**:**	**MI**

Course Learning Objectives

- To understand the key modules of digital communication systems with emphasis on digital modulation techniques.
- To get introduced to the basics of source and channel coding/decoding and Spread Spectrum Modulation.

Course Content

Base band transmission. Sampling theorem, Pulse code modulation (PCM), DM, Destination SNR in PCM systems with noise. Matched filter. Nyquist criterion for zero ISI. Optimum transmit and receive filters. Correlative Coding, M-ary PAM. Equalization- zero-forcing and basics of adaptive linear equalizers.

BASK, BFSK, and BPSK- Transmitter, Receiver, Signal space diagram, Error probabilities.

M-ary PSK, M-ary FSK, QAM, MSK and GMSK- Optimum detector, Signal constellation, error probability.

Linear block codes-Encoding and decoding. Cyclic codes – Encoder, Syndrome Calculator. Convolutional codes – encoding, Viterbi decoding. TCM.

Spread Spectrum (SS) Techniques- Direct Sequence Spread Spectrum modulation, Frequency-hop Spread Spectrum modulation - Processing gain and jamming margin.

Course outcomes

CO1: Apply the knowledge of signals and system and explain the conventional digital communication system.

CO2: Apply the knowledge of statistical theory of communication and evaluate the performance of digital communication system in the presence of noise.

CO3: Describe and analyze the performance of advance modulation techniques.

CO4: Apply the knowledge of digital electronics and describe the error control codes like block code, cyclic code.

CO5: Describe and analyze the digital communication system with spread spectrum modulation.

Text Books

1. *S.Haykin, "Communication Systems", Wiley, (4/e), 2001.*
2. *J.G.Proakis, "Digital Communication", Tata McGraw – Hill, (4/e), 2001.*

Reference Books

1. *B.Sklar, "Digital Communications: Fundamentals & Applications", Pearson Education, (2/e), 2001.*
2. *A.B.Carlson, " Communication Systems", McGraw Hill, 3/e,2002*
3. *R.E.Zimer & R.L.Peterson," Introduction to Digital Communication", PHI,3/e, 2001*

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Course Code	**:**	**ECMI19**
Course Title	**:**	**Wireless Communication**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECMI18**
Course Type	**:**	**MI**

Course Learning Objective

- To get an understanding of mobile radio communication principles, types and to study the recent trends adopted in cellular and wireless systems and standards**.**

Course Content

Introduction to Wireless Communication. Cellular concept. System design fundamentals. Coverage and Capacity improvement in Cellular system. Technical Challenges.

Mobile Radio Propagation; Reflection, Diffraction, Fading. Multipath propagation. Statistical characterization of multipath fading. Diversity Techniques.

Path loss prediction over hilly terrain. Practical link budget design using Path loss models. Design parameters at base station. Antenna location, spacing, heights and configurations.

Multiple access techniques; FDMA, TDMA and CDMA. Spread spectrum. Power control. WCDMA. CDMA network design. OFDM and MC-CDMA.

GSM.3G, 4G (LTE), NFC systems, WLAN technology. WLL. Hiper LAN. Ad hoc networks. Bluetooth.

Course outcomes
CO1: Apply the knowledge of basic communication systems and its principles.
CO2: Describe the cellular concept and analyze capacity improvement Techniques.
CO3: Mathematically analyze mobile radio propagation mechanisms.
CO4: Summarize diversity reception techniques.
CO5: Design Base Station (BS) parameters and analyze the antenna configurations.
CO6: Analyze and examine the multiple access techniques and its application.
CO7: Assess the latest wireless technologies.

Text Books:

1. *T.S.Rappaport, Wireless Communication Principles (2/e), Pearson, 2002.*
2. *A.F.Molisch, Wireless Communications, Wiley, 2005.*

Reference Books:

1. *P.MuthuChidambaraNathan, Wireless Communications, PHI, 2008.*
2. *W.C.Y.Lee, Mobile Communication Engineering. (2/e), McGraw- Hill, 1998.*
3. *A.Goldsmith, Wireless Communications, Cambridge University Press, 2005.*
4. *S.G.Glisic, Adaptive CDMA, Wiley, 2003.*

HONORS

Course Code	**:**	**ECHO11**
Course Title	**:**	**Advanced Digital Signal Processing**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC41**
Course Type	**:**	**HO**

Course learning Objectives

- To provide rigorous foundations in multirate signal processing, power spectrum estimation and adaptive filters.

Course Content

Review of sampling theory. Sampling rate conversion by integer and rational factors. Efficient realization and applications of sampling rate conversion.

Wiener filtering. Optimum linear prediction. Levinson- Durbin algorithm. Prediction error filters.

Adaptive filters. FIR adaptive LMS algorithm. Convergence of adaptive algorithms. Fast algorithms. Applications: Noise canceller, echo canceller and equalizer.

Recursive least squares algorithms. Matrix inversion lemma. Convergence analysis of the RLS algorithm. Adaptive beam forming. Kalman filtering.

Spectrum estimation. Estimation of autocorrelation. Periodogram method. Nonparametric methods. Parametric methods.

Course outcomes

CO1: summarize multirate DSP and design efficient digital filters.
CO2: construct multi-channel filter banks.
CO3: select linear filtering techniques to engineering problems.
CO4: describe the most important adaptive filter generic problems.
CO5: describe the various adaptive filter algorithms.
CO6: describe the statistical properties of the conventional spectral estimators.

Text books

1. J.G.Proakis, M. Salehi, “Advanced Digital Signal Processing”, McGraw –Hill,1992.
2. S.Haykin, “Adaptive Filter Theory (3/e)”, Prentice- Hall,1996.

Reference Books

1. D.G.Manolakis, V. K. Ingle, and S. M. Kogon ,”Statistical and Adaptive Signal Processing”, McGraw-Hill,2005
2. S.L.Marple,”Digital Spectral Analysis”,1987.
3. M.H.Hays,” Statistical Digital Signal Processing and Modeling”, John-Wiley,2001.

Course Code	**:**	**ECHO12**
Course Title	**:**	**Spectral Analysis of Signals**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC41**
Course Type	**:**	**HO**

Course learning Objectives

- To give an exhaustive survey of methods available for power spectrum estimation.

Course Content

Periodogram and correlogram. Blackman – Tukey, Bartlett, Welch and Daniel methods. Window design considerations.

Parametric methods for rational spectra. Covariance structure of ARMA processes. AR, MA and ARMA signals. Multivariate ARMA signals.

Parametric methods for line spectra. Models of sinusoidal signals in noise. Nonlinear least squares, high order Yule-Walker, min-norm, Pisarenko, MUSIC and ESPRIT methods.

Filter bank methods. Filter-bank interpretation of the periodogram. Refined filter-bank and Capon methods.

Spatial methods. Array model. Nonparametric methods; beam forming and Capon method. Parametric methods; nonlinear least squares, Yule-Walker, min-norm, Pisarenko, MUSIC and ESPRIT methods.

Course outcomes

CO1: derive and analyse the statistical properties of the conventional spectral estimators, namely the periodogram, averaged & modified periodogram and Blackman-Tukey methods.

CO2: formulate modern, parametric, spectral estimators based upon autoregressive (AR), moving average (MA), and autoregresive moving average (ARMA) models, and detail their statistical properties. Describe the consequence of the term resolution as applied to a spectral estimator.

CO3: define techniques for calculating moments in spectral and temporal domains; Analyze filter bank method, capon methods for spectrum estimation.

CO4: demonstrate knowledge and understanding of the principles of parametric and non-parametric array processing algorithms.

CO5: select an appropriate array processing algorithms for frequency estimation and sonar, radar applications.

Text books

1. P.Stoica & R.Moses, “Spectral Analysis of signals”, Pearson,2005.
2. Marple, “Introduction to Spectral Analysis”, Prentice Hall.

Reference Books

1. S.M.Key, “Fundamentals of Statistical Signal Processing”, Prentice Hall PTR, 1998.

Course Code	**:**	**ECHO13**
Course Title	**:**	**Detection and Estimation**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**MAIR45**
Course Type	**:**	**HO**

Course learning Objectives

- The objective of this course is to make the students conversant with those aspects of statistical decision and estimation which are indispensable tools required for the optimal design of digital communication systems.

Course Content

Binary hypothesis testing; Bayes, minimax and Neyman-Pearson tests. Composite hypothesis testing.

Signal detection in discrete time: Models and detector structures. Coherent detection in independent noise. Detection in Gaussian noise. Detection of signals with random parameters. Detection of stochastic signals. Performance evaluation of signal detectionprocedures.

Bayesian parameter estimation; MMSE, MMAE and MAP estimates. Nonrandom parameter estimation. Exponential families. Completeness theorem. ML estimation. Information inequality. Asymptotic properties ofMLEs.

Discrete time Kalman- Bucy filter. Linear estimation. Orthogonality principle. Wiener-Kolmogorov filtering – causal and noncausalfilters.

Signal detection in continous time:Detection of deterministic signals in Gaussian noise. Coherent detection in white Gaussian noise.

Course outcomes

CO1: summarize the fundamental concept on Statistical Decision Theory and Hypothesis Testing

CO2: summarize the various signal estimation techniques with additive noise

CO3: summarizer with Bayesian parameter estimation (minimum mean square error (MMSE), minimum mean absolute error (MMAE), maximum a-posterior probability (MAP) estimation methods).

CO4: compare optimal filtering, linear estimation, and Wiener/Kalman filtering. CO5: construct Wiener and Kalman filters (time discrete) and state space models.

Text Books

1. H.V.Poor, “An Introduction to Signal Detection and Estimation (2/e) Springer”,1994.
2. B.C.Levy, “Priciples of Signal Detection and Parameter Estimatio”n, Springer,2008.

Reference Books

1. H.L.Vantrees, “Detection, Estimation and Modulation theory”, Part I,Wiley,1987.
2. M.D.Srinath & P.K.Rajasekaran, “Statistical Signal Processing with Applications”, Wiley,1979.
3. J.C.Hancock & P.A. Wintz, “Signal Detection Theory”, Mc-Graw Hill,1966.

Course Code	**:**	**ECHO14**
Course Title	**:**	**Wavelet Signal Processing**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC41**
Course Type	**:**	**HO**

Course learning Objectives

- To expose the students to the basics of wavelet theory and to illustrate the use of wavelet processing for data compression and noise suppression.

Course Content

Limitations of standard Fourier analysis. Windowed Fourier transform. Continuous wavelet transform. Time-frequency resolution.

Wavelet bases. Balian-Low theorem. Multiresolution analysis. (MRA). Construction of wavelets from MRA. Fast wavelet algorithm.

Compactly supported wavelets. Cascade algorithm. Franklin and spline wavelets. Wavelet packets.
Hilbert space frames. Frame representation. Representation of signals by frames. Iterative reconstruction. Frame algorithm.

Wavelet methods for signal processing. Noise suppression. Representation of noise-corrupted signals using frames. Algorithm for reconstruction from corrupted frame representation.

Wavelet methods for image processing. Burt- Adelson and Mallat's pyramidal decomposition schemes. 2D-dyadic wavelet transform.

Course outcomes

CO1: understand about windowed Fourier transform and difference between windowed Fourier transform and wavelet transform.
CO2: understand wavelet basis and characterize continuous and discrete wavelet transforms
CO3: understand multi resolution analysis and identify various wavelets and evaluate their time-frequency resolution properties
CO4: implement discrete wavelet transforms with multirate digital filters
CO5: understand about wavelet packets
CO6: design certain classes of wavelets to specification and justify the basis of the application of wavelet transforms to different fields.

Text books

1. E.Hernandez & G.Weiss, A First Course on Wavelets, CRC Press, 1996.
2. L.Prasad & S.S.Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997.

Reference Books

1. A.Teolis, Computational Signal Processing with Wavelets, Birkhauser, 1998
2. R.M. Rao & A.S. Bopardikar, Wavelet Transforms, Addition Wesley, 1998.
3. J.C. Goswami & A.K. Chan, Fundamentals of Wavelets, John Wiley,1999.

Course Code	**:**	**ECHO15**
Course Title	**:**	**RF Circuits**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**HO**

Course learning Objectives

- To impart knowledge on basics of IC design at RF frequencies.

Course Content

Characteristics of passive IC components at RF frequencies – interconnects, resistors, capacitors, inductors and transformers – Transmission lines. Noise – classical two-port noise theory, noise models for active and passive components High frequency amplifier design – zeros as bandwidth enhancers, shunt-series amplifier,f doublers, neutralization and unilateralization

Low noise amplifier design – LNA topologies, power constrained noise optimization, linearity and large signal performance

Mixers – multiplier-based mixers, subsampling mixers, diode-ringmixers

RF power amplifiers – Class A, AB, B, C, D, E and F amplifiers, modulation of power amplifiers, linearity considerations

Oscillators & synthesizers – describing functions, resonators, negative resistance oscillators, synthesis with static moduli, synthesis with dithering moduli, combination synthesizers – phase noise considerations.

Course outcomes

CO1: Understand the Noise models for passive components and noise theory
CO2: Analyse the design of a high frequency amplifier
CO3: Appreciate the different LNA topologies & design techniques
CO4: Distinguish between different types of mixers
CO5: Analyse the various types of synthesizers, oscillators and their characteristics.

Text Books

1. T.homas H. Lee, “The Design of CMOS Radio-Frequency Integrated Circuits”, 2nd ed., Cambridge, UK: Cambridge University Press,2004.
2. B.Razavi, “RF Microelectronics”,2nd Ed., Prentice Hall,1998.

Reference Books

1. A.A. Abidi, P.R. Gray, and R.G. Meyer, eds., “Integrated Circuits for Wireless Communications”, New York: IEEE Press,1999.
2. R. Ludwig and P. Bretchko, “RF Circuit Design, Theory and Applications”, Pearson,2000.
3. Mattuck,A., “Introduction to Analysis”,Prentice-Hall,1998.

Course Code	**:**	**ECHO16**
Course Title	**:**	**Numerical Techniques for MIC**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC71**
Course Type	**:**	**HO**

Course learning Objectives

- This subject will prepare the student to face the challenging problem of the most important component of Research namely the numerical analysis.

Course Content

Over view of Numerical Techniques for Microwave I integrated Circuits: Introduction_Quasi Static and Full wave Analysis,Outline if Finite element method, Integral Equation Technique, Planar Circuit Analysis, Spectral Domain Approach, The Method of Lines, The Mode Matching Method, The Transverse Resonance Technique

The Finite Element Method Introduction The Method of Weighted Residuals The Variational Method Using a Variational Expression The Finite Element Method Integral Formulation of Problems Antennas and Scattering from Conductors Waveguides-Hollow,Dielectric and Optical Finite Difference in space and Time Matrix Computations A Finite Element Computer Program forMicrostrips

Planar Circuit Analysis Introduction Planar Circuit Analysis' Function Approach Impedence Green's Functions Contour Integral Approach Analysis of Planar Components of Composite Configurations Planar Circuits with Anisotropic Spacing Media Applications of the Planar Circuits Concept Summary

Spectral Domain Approach Introduction General Approach for Shielded Microstrip Lines The Immittance Approach Formulations for Slot lines, Fin lines, and Coplanar Waveguides Numerical Computation

Transverse Resonance Technique Introduction Inhomogeneous Waveguides Uniform Along a Traverse Coordinate Conventional Traverse Resonance Technique for Transversely Discontinuous Waveguides Generalized Transverse Resonance Technique for Transversely Discontinuous Inhomogeneous Analysis of Discontinuities and Junctions by the Generalized Transverse Resonance Technique Examples of Computer Programs

Course outcomes

CO1: bring awareness of the need for numerical analysis of M.I.C. And prepare to formulate all popular numerical techniques of M.I.C.
CO2: make one formulate and write coding for Finite Element Method
CO3: prepare a person to be strong in the planar circuit Analysis
CO4: bring awareness of the most popular Quasi state analysis Spectral Domain Techniques
CO5: prepare the student formulate and write coding for the Transverse ResonanceTechniques

Text Book

1. T.Itoh, Numerical Techniques for Microwave Integrated Circuits., John Wiley and sons,1989

Course Code	**:**	**ECHO17**
Course Title	**:**	**Applied Photonics**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**HO**

Course learning Objectives

- To prepare the students understand the fundamental principles of light-matter interaction and photonic band gap structures.
- To enable the students appreciate the diverse applications of fiber optic sensors.

Course Content

Introduction to photonics; optical waveguide theory; Interference of light waves -numerical techniques and simulation

Photonic waveguide components Optical Modulators and Switches Electro-optics - Acousto-optics - Magneto-optics

Photonic Band gap Structures: Concept of photonic crystal; bandgap and band structures in 1D, 2D and 3D photonic crystal structures;

Photo-refractive materials, non-linear optics, recent trends in bio andnano-photonics

Optical fiber sensors - Sensing using optical fibers - Types:-Amplitude, Interferometric, Wavelength, Polarimetric – Distributed Sensors

Course outcomes

CO1: understand the interference of light and optical waveguide theory.
CO2: understand the significance of photonic band gap structures and their application
CO3: analyse the different types of optical modulators.
CO4: compare the merits and demerits of different types of fiber optic sensors.
CO5: understand the application of nonlinear optics in bio and nanophotonics.

Text Books

1. A. Ghatak and K. Thyagarajan, “Introduction to Fiber Optics”, Cambridge University Press,2006.
2. Pochi Yeh and Amnon Yariv Photonics,” Optical Electronics in Modern Communications”,2007

Reference Books

1. F. T. S. Yu and S.Yin, “Fiber Optic Sensors”, Marcel Dekker, Inc2002
2. G. W. Hanson, “Fundamentals of Nanoelectronics “,Pearson Education, 1st edition,2008
3. B. Saleh and M. Teich, “Fundamentals of Photonics”, Wiley & Sons(2007)

Course Code	**:**	**ECHO18**
Course Title	**:**	**Advanced Radiation Systems**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC64**
Course Type	**:**	**HO**

Course learning Objectives

- To prepare the students understand the operating principles of various RF radiating systems.
- To enable the students appreciate the diverse applications of radiating systems.
- To design the suitable antenna systems to serve a defined application.

Course Content

Antenna Fundamentals: Antenna fundamental parameters, Radiation integrals, Radiation from surface and line current distributions – dipole, monopole, loop antenna; Broadband antennas and matching techniques, Balance to unbalance transformer, Introduction to numerical techniques.

Apertures Antennas: Field equivalence principle, Radiation from Rectangular and Circular apertures, Uniform aperture distribution on an infinite ground plane; Slot antenna; Horn antenna; Reflector antenna, aperture blockage, and design consideration.

Arrays: General structure of phased array, linear array theory, variation of gain as a function of pointing direction, frequency scanned arrays, digital beam forming, and MEMS technology in phased arrays-Retro directive and self phasedarrays.

Micro Strip Antenna: Radiation Mechanism from patch; Excitation techniques; Microstrip dipole; Rectangular patch, Circular patch, and Ring antenna – radiation analysis from transmission line model, cavity model; input impedance of rectangular and circular patch antenna; Application of microstrip array antenna.

Terahertz Planar Antennas: Electronics band gap materials - Photonic Band-gap Structures-Tera Hertz Patch antennas-Special antenna structures.

Course outcomes

CO1: understand the various antenna parameters and different impedance matching techniques.
CO2: understand the working principle of apertures antennas.
CO3: analyze how the electronic beam formation is done using array of antennas.
CO4: compare the merits and demerits of various microwave patch antenna structures.
CO5: understand the photonic band gap structures and its application in terahertz antennas.

Text Books

1. S. Haykins," Communication Systems", John Wiley, 3rd edition,1995.
2. RR Gulathi, "Monochrome and Colour Television", New Age International Publishers, 2nd edition, 2005.
3. J. G. Proakis& M .Salehi," Communication Systems Engineering", Prentice Hall, 2nd edition,2002.

Reference Books

1. Kennedy & Davis," Electronic Communication systems", Tata McGraw Hill, 4th edition,1999.

Course Code	**:**	**ECHO19**
Course Title	**:**	**Bio MEMS**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC44**
Course Type	**:**	**HO**

Course learning Objectives

- To train the students in the design aspects of Bio MEMS devices and Systems. To make the students aware of applications in various medical specialists especially the Comparison of conventions methods and Bio MEMS usage.

Course Content

Introduction: The driving force behind Biomedical Applications-Biocompatibility-Reliability Considerations-Regularity Considerations-Organizations-Education of Bio MEMS-Silicon Micro fabrication-Soft Fabrication techniques

Micro fluidic Principles: Introduction-Transport Processes- Electro kinetic Phenomena-Micro valves –Micro mixers- Micropumps.

Sensor Principles and Micro Sensors: Introduction-Fabrication-Basic Sensors-Optical fibers-Piezo electricity and SAW devices-Electrochemical detection-Applications in Medicine

Micro Actuators and Drug Delivery: Introduction-Activation Methods-Micro actuators for Micro fluidics-equivalent circuit representation-Drug Delivery

Micro Total Analysis: Lab on Chip-Capillary Electrophoresis Arrays-cell, molecule and Particle Handling-Surface Modification-Microsphere-Cell based Bioassay Systems

Detection and Measurement Methods: Emerging Bio MEMS Technology-Packaging, Power, Data and RF Safety-Biocompatibility, Standards

Course outcomes

CO1: learn and realize the MEMS applications in Bio Medical Engineering
CO2: understand the Micro fluidic Principles and study its applications.
CO3: learn the applications of Sensors in Health Engineering.
CO4: learn the principles of Micro Actuators and Drug Delivery system
CO5: learn the principles and applications of Micro Total Analysis

Text Book

1. S.S. Saliterman,” Fundamentals of Bio MEMS and Medical Micro devices”, Wiley Interscience, 2006.

Reference Books

1. A. Folch ,”Introduction to Bio MEMS”, CRC Press,2012
2. G.A. Urban, “Bio MEMS”, Springer,2006
3. W. wang, S.A. Soper,” Bio MEMS”,2006.
4. M. J. Madou, “Fundametal of Micro fabrication”,2002.
5. G.T. A. Kovacs, “Micro machined TransducersSourcebook”,1998.

Course Code	**:**	**ECHO20**
Course Title	**:**	**Analog IC Design**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC54**
Course Type	**:**	**HO**

Course learning Objectives

- To develop the ability design and analyze MOS based Analog VLSI circuits to draw the equivalent circuits of MOS based Analog VLSI and analyze their performance.
- To develop the skills to design analog VLSI circuits for a given specification.

Course Content

Basic MOS Device Physics – General Considerations, MOS I/V Characteristics, Second Order effects, MOS Device models. Short Channel Effects and Device Models. Single Stage Amplifiers – Basic Concepts, Common Source Stage, Source Follower, Common Gate Stage, Cascode Stage.

Differential Amplifiers – Single Ended and Differential Operation, Basic Differential Pair, Common-Mode Response, Differential Pair with MOS loads, Gilbert Cell. Passive and Active Current Mirrors – Basic Current Mirrors, Cascode Current Mirrors, Active CurrentMirrors.

Frequency Response of Amplifiers – General Considerations, Common Source Stage, Source Followers, Common Gate Stage, Cascode Stage, Differential Pair. Noise – Types of Noise, Representation of Noise in circuits, Noise in single stage amplifiers, Noise in DifferentialPairs.

Feedback Amplifiers – General Considerations, Feedback Topologies, Effect of Loading. Operational Amplifiers – General Considerations, One Stage Op Amps, Two Stage Op Amps, Gain Boosting, Common-Mode Feedback, Input Range limitations, Slew Rate, Power Supply Rejection, Noise in Op Amps. Stability and Frequency Compensation.

Bandgap References, Introduction to Switched Capacitor Circuits, Nonlinearity and Mismatch.

Course outcomes

CO1: draw the equivalent circuits of MOS based Analog VLSI and analyze their performance.
CO2: design analog VLSI circuits for a given specification.
CO3: Analyse the frequency response of the different configurations of a amplifier.
CO4: Understand the feedback topologies involved in the amplifier design.
CO5: Appreciate the design features of the differential amplifiers.

Text Books

1. B.Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill Edition2002.
2. Paul. R.Gray, Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley, (4/e), 2001.

Reference Books

1. D. A. Johns and K. Martin, "Analog Integrated Circuit Design", Wiley,1997.
2. R. Jacob Baker, "CMOS Circuit Design, Layout, and Simulation", Wiley, (3/e),2010.
3. P.E.Allen, D.R. Holberg, "CMOS Analog Circuit Design", Oxford University Press,2002.

Course Code	**:**	**ECHO21**
Course Title	**:**	**VLSI System Testing**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC63**
Course Type	**:**	**HO**

Course learning Objectives

- To expose the students, the basics of testing techniques for VLSI circuits and Test Economics.

Course Content

Basics of Testing: Fault models, Combinational logic and fault simulation, Test generation for Combinational Circuits. Current sensing based testing. Classification of sequential ATPG methods. Fault collapsing and simulation

Universal test sets: Pseudo-exhaustive and iterative logic array testing. Clocking schemes for delay fault testing. Testability classifications for path delay faults. Test generation and fault simulation for path and gate delay faults.

CMOS testing: Testing of static and dynamic circuits. Fault diagnosis: Fault models for diagnosis, Cause- effect diagnosis, Effect-causediagnosis.

Design for testability: Scan design, Partial scan, use of scan chains, boundary scan, DFT for other test objectives, MemoryTesting.

Built-in self-test: Pattern Generators, Estimation of test length, Test points to improve testability, Analysis of aliasing in linear compression, BIST methodologies, BIST for delay faulttesting.

Course outcomes

CO1: apply the concepts in testing which can help them design a better yield in IC design.

CO2: tackle the problems associated with testing of semiconductor circuits at earlier design levels so as to significantly reduce the testing costs.

CO3: analyse the various test generation methods for static & dynamic CMOS circuits

CO4: identify the design for testability methods for combinational & sequential CMOS circuits.

CO5: recognize the BIST techniques for improvingtestability.

Text Books

1. N. Jha & S.D. Gupta, “Testing of Digital Systems”, Cambridge,2003.
2. W. W. Wen, “VLSI Test Principles and Architectures Design for Testability”, Morgan Kaufmann Publishers.2006

Reference Books

1. Michael L. Bushnell &Vishwani D. Agrawal,” Essentials of Electronic Testing for Digital, memory & Mixed signal VLSI Circuits”, Kluwar Academic Publishers.2000.
2. P. K. Lala,” Digital circuit Testing and Testability”, Academic Press.1997.
3. M. Abramovici, M. A. Breuer, and A.D. Friedman, “Digital System Testing and Testable Design”, Computer Science Press,1990.

Course Code	**:**	**ECHO22**
Course Title	**:**	**Electronic Design Automation Tools**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**HO**

Course learning Objectives

- To make the students exposed to Front end and Back end VLSI CAD tools.

Course Content

An overview of OS commands. System settings and configuration. Introduction to UNIX commands. Writing Shell scripts. VLSI design automation tools. An overview of the features of practical CAD tools. Modelsim, Leonardo spectrum, ISE 13.1i, Quartus II, VLSI backendtools.

Synthesis and simulation using HDLs-Logic synthesis using verilog and VHDL. Memory and FSM synthesis. Performance driven synthesis, Simulation- Types of simulation. Static timing analysis. Formal verification.Switchlevelandtransistorlevelsimulation.

Circuit simulation using Spice: Circuit description.AC, DC and transient analysis. Advanced spice commands and analysis. Models for diodes, transistors and opamp. Digital building blocks.A/D, D/A and sample and hold circuits. Design and analysis of mixed signalcircuits.

System Verilog- Introduction, Design hierarchy, Data types, Operators and language constructs. Functional coverage, Assertions, Interfaces and test benchstructures.

Mixed signal circuit modeling and analysis, Concept of System on chip. Introduction to Cypress Programmable System on Chip (PSoC). Structure of PSoC, PSoC Designer, PSoC Modules, Interconnects, Memory Management, Global Resources, and DesignExamples.

Course outcomes

CO1: understand the special features of VLSI back end and front end CAD tools and Unix shell script

CO2: write synthesizable verilog and VHDLcode.

CO3: write Pspice code for any electronics circuit and to perform monte-carlo analysis and sensitivity/worst case analysis.

CO4: understand the difference between verilog and system verilog and are able to write system verilog code.

CO5: understand Cypress PSOC structure, modules and interconnects.

Text Books

1. M.J.S.Smith, “Application Specific Integrated Circuits”,Pearson,2008.
2. M.H.Rashid, “Introduction to PSpice usingOrCAD for circuits and electronics”,Pearson,2004.
3. S. Sutherland,S.Davidmann, P. Flake,”System Verilog For Design”,(2/e), Springer,2006.

Reference Books

1. Z. Dr Mark,”Digital System Design with System Verilog”,Pearson,2010.
2. R. Ashby,”Designer's Guide to the Cypress PSoC,Newnes (An imprint of Elsevier)”,2006.
3. O. H. Bailey,”The Beginner's Guide to PSoC”, Express Timelines IndustriesInc.,2007.

Course Code	**:**	**ECHO23**
Course Title	**:**	**Design Of ASICs**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**HO**

Course learning Objectives

- To prepare the student to be an entry-level industrial standard ASIC or FPGA designer.
- To give the student an understanding of issues and tools related to ASIC/FPGA design and implementation.
- To give the student an understanding of basics of System on Chip and Platform based design.

Course Content

Types of ASICs, VLSI Design flow, Programmable ASICs - Antifuse, SRAM, EPROM, EEPROM based ASICs. Programmable ASIC logic cells and I/O cells. Programmable interconnects. Latest Version - FPGAs and CPLDs and Soft-core processors.

Trade off issues at System Level: Optimization with regard to speed, area and power, asynchronous and low power system design. ASIC physical design issues, System Partitioning, Power Dissipation, Partitioning Methods.

ASIC floor planning, Placement and Routing.

System-On-Chip Design - SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures, On-Chip Communication Architecture Standards, Low-Power SoCDesign

High performance algorithms for ASICS/ SoCs as case studies – Canonic Signed Digit Arithmetic, KCM, Distributed Arithmetic, High performance digital filters for sigma-delta ADC, USB controllers,OMAP.

Course outcomes

CO1: demonstrate VLSI tool-flow and appreciate FPGA architecture.

CO2: understand the issues involved in ASIC design, including technology choice, design management, tool-flow, verification, debug and test, as well as the impact of technology scaling on ASIC design.

CO3: understand the algorithms used for ASIC construction

CO4: understand the basics of System on Chip, On chip communication architectures like AMBA, AXI and utilizing Platform based design.

CO5: appreciate high performance algorithms available for ASICs

Text Book

1. M.J.S. Smith,“Application Specific Integrated Circuits”, Pearson,2003

Reference Books

1. H.Gerez, “Algorithms for VLSI Design Automation”, John Wiley,1999
2. J..M.Rabaey, A. Chandrakasan, and B.Nikolic, ”Digital Integrated Circuit Design Perspective (2/e)”, PHI2003
3. D. A.Hodges, “Analysis and Design of Digital Integrated Circuits (3/e)”, MGH2004
4. Hoi-Jun Yoo, Kangmin Leeand Jun Kyong Kim, “Low-Power NoC for High-Performance SoC Design”, CRC Press,2008
5. S.Pasricha and N.Dutt,” On-Chip Communication Architectures System on Chip Interconnect, Elsveir”, 2008

Course Code	**:**	**ECHO24**
Course Title	**:**	**Digital System Design**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC35**
Course Type	**:**	**HO**

Course learning Objectives

- To get an idea about designing complex, high speed digital systems and how to implement such design.

Course Content

Mapping algorithms into Architectures: Data path synthesis, control structures, critical path and worst case timing analysis. FSM and Hazards.

Combinational network delay. Power and energy optimization in combinational logic circuit. Sequential machine design styles. Rules for clocking. Performance analysis.

Sequencing static circuits. Circuit design of latches and flip-flops. Static sequencing element methodology. Sequencing dynamic circuits .Synchronizers.

Data path and array subsystems: Addition / Subtraction, Comparators, counters, coding, multiplication and division. SRAM, DRAM, ROM, serial access memory, context addressable memory.

Reconfigurable Computing- Fine grain and Coarse grain architectures, Configuration architectures-Single context, Multi context, Partially reconfigurable, Pipeline reconfigurable, Block Configurable, Parallel processing.

Course outcomes

CO1: identify mapping algorithms into architectures.

CO2: summarize various delays in combinational circuit and its optimization methods.

CO3: summarize circuit design of latches and flip-flops.

CO4: construct combinational and sequential circuits of medium complexity that is based on VLSIs, and programmable logic devices.

CO5: summarize the advanced topics such as reconfigurable computing, partially reconfigurable, Pipeline reconfigurable architectures and block configurable.

Text Books

1. N.H.E.Weste, D. Harris, CMOS VLSI Design (3/e), Pearson,2005.
2. W.Wolf, FPGA- based System Design, Pearson,2004.
3. S. Hauck, A.DeHon,"Reconfigurable computing: the theory and practice of FPGA-based computation", Elsevier,2008.

Reference Books

1. Franklin P. Prosser, David E. Winkel, Art of Digital Design, . Prentice-Hall,1987.
2. R.F.Tinde," Engineering Digital Design", (2/e), Academic Press,2000.
3. C. Bobda, "Introduction to reconfigurable computing",Springer,2007.
4. M. Gokhale,"Paul S. Graham, Reconfigurable computing: accelerating computation with field- programmable gate arrays", Springer,2005.
5. C.Roth, "Fundamentals of Digital Logic Design", Jaico Publishers, V ed.,2009.

Course Code	**:**	**ECHO25**
Course Title	**:**	**Digital Signal Processing Structures for VLSI**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC52 & ECPC63**
Course Type	**:**	**HO**

Course learning Objectives

- To make an in depth study of DSP structures amenable to VLSI implementation.
- To enable students to design VLSI system with high speed and low power.
- To make the students to implement DSP algorithm in an optimized method.

Course Content

An overview of DSP concepts, Representations of DSP algorithms. Loop bound and iteration bound. Transformation Techniques: Retiming, Folding and Unfolding

Pipelining of FIR filters. Parallel processing of FIR filters. Pipelining and parallel processing for low power, Combining Pipelining and Parallel Processing. Systolic Architecture Design

Pipeline interleaving in digital filters. Pipelining and parallel processing for IIR filters. Low power IIR filter design using pipelining and parallel processing, Pipelined adaptive digital filters.

Synchronous pipelining and clocking styles, clock skew and clock distribution in bit level pipelined VLSI designs. Wave pipelining, constraint space diagram and degree of wave pipelining, Implementation of wave- pipelined systems, Asynchronous pipelining.

Course outcomes

CO1: understand the overview of DSP concepts

CO2: improve the speed of digital system through transformation techniques.

CO3: perform Pipelining and parallel processing in FIR systems to achieve high speed and low power.

CO4: perform Pipelining and parallel processing in IIR systems and adaptive filters

CO5: understand clocking issues and asynchronous system.

Text Book

1. K.K.Parhi, “VLSI Digital Signal Processing Systems”, John-Wiley,2007

Reference Book

1. U. Meyer -Baese,” Digital Signal Processing with FPGAs”, Springer,2004
2. W.Burleson,K. Konstantinides,T.H. Meng,” VLSI SignalProcessing””,1996.
3. R.J. Higgins, “Digital signal processing in VLSI”,1990.
4. S.Y.Kung,H.J. Whitehouse, “VLSI and modern signal processing”,1985

Course Code	**:**	**ECHO26**
Course Title	**:**	**Low Power VLSI Circuits**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC63**
Course Type	**:**	**HO**

Course learning Objectives

- To expose the students to the low voltage device modeling, low voltage, low power VLSI CMOS circuit design.

Course Content

Evolution of CMOS technology.0.25 µm and 0.1 µm technologies. Shallow trench isolation. Lightly-doped drain. Buried channel. BiCMOS and SOI CMOS technologies. Second order effects and capacitance of MOSdevices.

CMOS inverters, static logic circuits of CMOS, pass transistor, BiCMOS, SOI CMOS and low power CMOStechniques.

Basic concepts of dynamic logic circuits. Various problems associated with dynamic logic circuits. Differential, BiCMOS and low voltage dynamic logiccircuits.

Different types of memorycircuits.

Adder circuits, Multipliers and advanced structures – PLA, PLL and Processingunit.

Course outcomes

CO1: acquire the knowledge about various CMOS fabrication process and its modeling.
CO2: infer about the second order effects of MOS transistor characteristics.
CO3: analyze and implement various CMOS static logic circuits.
CO4: learn the design of various CMOS dynamic logic circuits.
CO5: learn the design techniques low voltage and low power CMOS circuits for various applications.
CO6: learn the different types of memory circuits and their design.
CO7: design and implementation of various structures for low power applications.

Text Books

1. Jan Rabaey,"Low Power Design Essentials (Integrated Circuits and Systems)", Springer,2009
2. J.B.Kuo&J.H.Lou,"Low-voltage CMOS VLSI Circuits", Wiley,1999.

Reference Book

1. A.Bellaowar&M.I.Elmasry,"Low power Digital VLSI Design, Circuits and Systems", Kluwer, 1996.

Course Code	**:**	**ECHO27**
Course Title	**:**	**VLSI Digital Signal Processing Systems**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC41 & ECPC63**
Course Type	**:**	**HO**

Course learning Objectives

- To give an in-depth coverage of advanced VLSI Digital Signal Processing Systems.
- To provide knowledge about the effect of finite wordlength.
- To learn regarding the efficient implementation of arithmetic units.

Course Content

Algorithms for fast convolution, Algorithmic strength reduction in filters and transforms: Parallel FIR Filters, DCT and inverse DCT, Parallel Architectures for Rank-OrderFilters.

Scaling and Round off Noise - State variable description of digital filters, Scaling and Round off Noise computation, Round off Noise in Pipelined IIR Filters, Round off Noise Computation using state variable description, Slow-down, Retiming and Pipelining.

Bit level arithmetic Architectures- parallel multipliers, interleaved floor-plan and bit-plane-based digital filters, Bit serial multipliers, Bit serial filter design and implementation, Canonic signed digit arithmetic, Distributed arithmetic.

Redundant arithmetic -Redundant number representations, carry free radix-2 addition and subtraction, Hybrid radix-4 addition, Radix-2 hybrid redundant multiplication architectures, data format conversion, Redundant to Nonredundant converter.

Numerical Strength Reduction - Subexpression Elimination, Multiple Constant Multiplication, Subexpression Sharing in Digital Filters, Additive and Multiplicative NumberSplitting.

Course outcomes

CO1: learn various transforms and its corresponding architectures

CO2: acquire the knowledge of effect of round off noise computation

CO3: design Bit level arithmetic Architectures and optimize the implementation of FIR filters and constant multipliers

CO4: design basic arithmetic units and realize their architecture for higher radices

CO5: learn different numerical strength reduction techniques

Text Book

1. K.K.Parhi, “VLSI Digital Signal Processing Systems”, John-Wiley,2007

Reference Book

1. U. Meyer -Baese, Digital Signal Processing with FPGAs, Springer,2004
2. W.Burleson,Konstantinos Konstantinides,Teresa H. Meng, VLSI SignalProcessing,1996.
3. R. J. Higgins,Digital signal processing in VLSI,1990.
4. Sun Yuan Kung,Harper J. Whitehouse, VLSI and modern signal processing,1985
5. M. A. Bayoumi, VLSI Design Methodologies for Digital Signal Processing,2012
6. Earl E. Swartzlander, VLSI signal processing systems,1986.

Course Code	**:**	**ECHO28**
Course Title	**:**	**Asynchronous System Design**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC35**
Course Type	**:**	**HO**

Course learning Objectives

- This subject introduces the fundamentals and performance of Asynchronous system
- To familiarize the dependency graphical analysis of signal transmission graphs
- To learn software languages and its syntax and operations for implementing Asynchronous Designs

Course Content

Fundamentals: Handshake protocols, Muller C-element, Muller pipeline, Circuit implementation styles, theory. Static data-flow structures: Pipelines and rings, Building blocks, examples

Performance: A quantitative view of performance, quantifying performance, Dependency graphic analysis. Handshake circuit implementation: Fork, join, and merge, Functional blocks, mutual exclusion, arbitration and metastability.

Speed-independent control circuits: Signal Transition graphs, Basic Synthesis Procedure, Implementation using state-holding gates, Summary of the synthesis Process, Design examples using Petrify. Advanced 4- phase bundled data protocols and circuits: Channels and protocols, Static type checking, More advanced latch controlcircuits.

High-level languages and tools: Concurrency and message passing in CSP, Tangram program examples, Tangram syntax-directed compilation, Martin’s translation process, Using VHDL for Asynchronous Design. An Introduction to Balsa: Basic concepts, Tool set and design flow, Ancillary BalsaTools

The Balsa language: Data types, Control flow and commands, Binary/Unary operators, Program structure. Building library Components: Parameterized descriptions, Recursive definitions. A simple DMA controller: Global Registers, Channel Registers, DMA control structure, The Balsa description.

Course outcomes

CO1: understand the fundamentals of Asynchronous protocols

CO2: analyze the performance of Asynchronous System and implement handshake circuits

CO3: understand the various control circuits and Asynchronous system modules

CO4: gain the experience in using high level languages and tools for Asynchronous Design

CO5: learn commands and control flow of Balsa language for implementing Asynchronous Designs

Text Books

1. Asynchronous Circuit Design- Chris. J. Myers, John Wiley &Sons,2001.
2. Handshake Circuits An Asynchronous architecture for VLSI programming – KeesVanBerkel Cambridge University Press,2004

Reference Book

1. Principles of Asynchronous Circuit Design-Jens Sparso, Steve Furber, Kluver Academic Publishers, 2001.
2. Asynchronous Sequential Machine Design and Analysis, Richard F. Tinder,2009
3. A Designer's Guide to Asynchronous VLSI, Peter A. Beerel, Recep O. Ozdag, Marcos Ferretti,2010

Course Code	**:**	**ECHO29**
Course Title	**:**	**Physical Design Automation**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**HO**

Course learning Objectives

- Understand the concepts of Physical Design Process such as partitioning, Floor planning, Placement and Routing.
- Discuss the concepts of design optimization algorithms and their application to physical design automation.
- Understand the concepts of simulation and synthesis in VLSI Design Automation
- Formulate CAD design problems using algorithmic methods

Course Content

VLSI design automation tools- algorithms and system design. Structural and logic design. Transistor level design. Layout design. Verification methods. Design management tools.
Layout compaction, placement and routing. Design rules, symbolic layout. Applications of compaction. Formulation methods. Algorithms for constrained graph compaction. Circuit representation. Wire length estimation. Placement algorithms. Partitioning algorithms.
Floor planning and routing- floor planning concepts. Shape functions and floor planning sizing. Local routing. Area routing. Channel routing, global routing and its algorithms.
Simulation and logic synthesis- gate level and switch level modeling and simulation. Introduction to combinational logic synthesis. ROBDD principles, implementation, construction and manipulation. Two level logic synthesis.
High-level synthesis- hardware model for high level synthesis. Internal representation of input algorithms. Allocation, assignment and scheduling. Scheduling algorithms. Aspects of assignment. High level transformations.

Course outcomes

CO1: know how to place the blocks and how to partition the blocks while for designing the layout for IC.
CO2: solve the performance issues in circuit layout.
CO3: analyze physical design problems and Employ appropriate automation algorithms for partitioning, floor planning, placement and routing
CO4: decompose large mapping problem into pieces, including logic optimization with partitioning, placement and routing
CO5: analyze circuits using both analytical and CAD tools

TextBooks

1. S.H. Gerez, “A lgorithms for VLSI Design Automation”, John Wiley,1998.
2. N.A.Sherwani , “Algorithms for VLSI Physical Design Automation”, (3/e),Kluwer,1999.

Reference Books

1. S.M. Sait , H. Youssef, “VLSI Physical Design Automation”, World scientific,1999.
2. M.Sarrafzadeh, “Introduction to VLSI Physical Design”, McGraw Hill (IE),1996.

Course Code	**:**	**ECHO30**
Course Title	**:**	**Mixed - Signal Circuit Design**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**NONE**
Course Type	**:**	**HO**

Course learning Objectives

- To make the students to understand the design and performance measures concept of mixed signal circuit.

Course Content

Concepts of Mixed-Signal Design and Performance Measures. Fundamentals of Data Converters.Nyquist Rate Converters and Over sampling Converters.
Design methodology for mixed signal IC design using gm/Id concept.
Design of Current mirrors. References. Comparators and Operational Amplifiers.
CMOS Digital Circuits Design: Design of MOSFET Switches and Switched-Capacitor Circuits, Layout Considerations.
Design of frequency and Q tunable continuous time filters.

Course outcomes

CO1: Appreciate the fundamentals of data converters and also optimized their performances.
CO2: Understand the design methodology for mixed signal IC design using gm/Id concept.
CO3: Analyze the design of current mirrors and operational amplifiers
CO4: Design the CMOS digital circuits and implement its layout.
CO5: design the frequency and Q tunable time domain filters.

Text Books

1. R. Jacob Baker, Harry W. Li, David E. Boyce, CMOS, Circuit Design, Layout, and Simulation, Wiley-IEEE Press,1998
2. David A. Johns and Ken Martin, Analog Integrated Circuit Design, John Wiley and Sons,1997.

Course Code	**:**	**ECHO31**
Course Title	**:**	**Digital Signal Processing For Medical Imaging**
Number of Credits	**:**	**3**
Prerequisites (Course code)	**:**	**ECPC52**
Course Type	**:**	**HO**

Course Content

X-ray projection imaging-X-ray Generation-X-ray attenuation –X-ray Detectors- Factors that determine X-ray image quality - Introduction to Computed Tomography (CT) – Parallel Beam projection- Fan Beam projection- Relationship between Parallel beam and Fan beam projection-Discrete Realization.

Introduction to Magnetic resonance imaging-Bloch equation-Larmor frequency and the tip angle –Trick on MRI- Selecting the human slice and the corresponding external RF pulse- Measurement of the Transverse component using the receiver antenna-Sampling the MRI image in the frequency domain-Practical difficulties and remedies in MRI Proton-Density, MRI image – T_2 MRI image using Spin-Echo and Cartesian scanning -T_2 MRI image using spin-echo and polar scanning - T_1 MRI image.

Nuclear Imaging-Radiopharmaceuticals-Production of short-lived radioactive tracers-Detector systems and the Anger camera-Single photon Emission computed tomography-Positron Emission Tomography-Multi-modality Imaging.

Ultrasound imaging-sound propagation in Biological Tissue-Ultrasound Image formation-Ultra sound Generation and Echo Detection-A-mode scans-B-mode scans-M-mode scans-Volumetric scans and 3D Ultrasound – Doppler ultrasound.

Medical image processing-Image Enhancement- Logarithmic display- Non-linear filtering-Image subtraction-Linear filtering and the Hankel transformation - Histogram equalization - Histogram specification. Medical image compression-Discrete Cosine Transformation-Hoteling transformation-Feature extraction and classification-Dimensionality reduction using Principle component analysis-Linear Discriminant analysis - Kernel-Linear discriminant analysis.

Course outcomes

CO1: Describe the signal processing techniques involved in CT based Imaging techniques
CO2: Describe the signal processing techniques involved in MRI based Imaging techniques
CO3: Describe the signal processing techniques involved in Nuclear Imaging
CO4: Describe the signal processing techniques involved in Ultra sound Imaging
CO5: Describe the signal processing techniques involved in Medical image processing

Text Books

1. Jerry L. Prince, Jonathan M. Links, Medical imaging signals and systems, Pearson education, second edition, 2014
2. Mark. A. Haidekkar, Medical Imaging technology, Springer briefs in physics,2013
3. E.S. Gopi, Digital signal processing for medical imaging using Matlab, Springer, 2013

Reference Books

1. Paul suetens, Fundamentals of medical imaging, second edition, Cambridge university press, 2009.
2. MIT course: http://ocw.mit.edu/courses/nuclear-engineering/22-058-principles-of-medical-imaging-fall-2002/index.htm