Indian Institute of Information Technology Kalyani

Autonomous institution under MoE, Govt. Of India & Department of Information Technology & Electronics, Govt. of West Bengal, WEBEL IT Park Campus, West Bengal 741235, India

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Course Structure and Syllabus

for

4 Years B. Tech.

in

Electronics and Communication Engineering

Indian Institute of Information Technology Kalyani

WEBEL IT Park Campus

West Bengal 741235, India

Course Structure

1st Year (Semester: I)							
Sl No.	Code No.	Subject	Contact Periods/Week				Credits
			L	T	P	Total	
Theoretical Papers							
1	MAC101	Mathematics - I (Linear Algebra)	3	1	0	4	4
2	PHC101	Physics	3	1	0	4	4
3	ECC101	Basic Electrical and Electronics Engineering	3	0	0	3	3
4	CSC101	Programming -I (C Language)	3	0	0	3	3
5	HUC101	English for Communication	3	0	0	3	3
6	HUC102	Humanities - I (Values & Ethics in Profession)	3	0	0	3	3
Sessional Papers							
7	CSC111	Programming-I (C Language) Laboratory	0	0	3	3	2
8	ECC111	Basic Electronics Engineering Laboratory	0	0	3	3	2
Total			**18**	**2**	**6**	**26**	**24**

1st Year (Semester: II)							
Sl No.	Code No.	Subject	Contact Periods/Week				Credits
			L	T	P	Total	
Theoretical Papers							
1	MAC201	Mathematics-II (Probability and Statistics)	3	1	0	4	4
2	PHC201	Physics II	3	1	0	4	4
3	ECC201	Digital Logic Design and Circuit	3	0	0	3	3
4	CSC201	Data Structures and Algorithms	3	1	0	4	4
5	HUC201	Humanities - II (Economics)	3	0	0	3	3
Sessional Papers							
6	ECC211	Digital Logic Design and Circuit Laboratory	0	0	3	3	2
7	CSC211	Data Structures and Algorithms Laboratory	0	0	3	3	2
Total			**15**	**3**	**6**	**24**	**22**

2nd Year (Semester: III)							
Sl No.	Code No.	Subject	Contact Periods/Week				Credits
			L	T	P	Total	
Theoretical Papers							
1	MAC301	Mathematics-III (Calculus and Differential Equations)	3	1	0	4	4
2	ECC301	Signals and Systems	3	1	0	4	4
3	ECC302	Semiconductor Devices	3	1	0	4	4
4	CSC301	Computer Organization and Architecture	3	0	0	3	3
5	HUC301	Humanities - III (Psychology)	3	0	0	3	3
Sessional Papers							
6	ECC312	Semiconductor Devices Laboratory	0	0	3	3	2
7	CSC311	Computer Organization and Architecture Laboratory	0	0	3	3	2
Total			**15**	**3**	**6**	**24**	**22**

2nd Year (Semester: IV)							
Sl No.	Code No.	Subject	Contact Periods/Week				Credits
			L	T	P	Total	
Theoretical Papers							
1	ECC401	Circuit Theory	3	1	0	4	4
2	ECC402	Analog Electronic Circuits	3	1	0	4	4
3	ECC403	Electromagnetic Engineering	3	1	0	4	4
4	ECC404	Statistical Signal Processing	3	1	0	4	4
5	HUC401	IPR Law: Concepts and Applications	3	0	0	3	3
Sessional Papers							
6	ECC411	Circuit Theory Laboratory	0	0	3	3	2
7	ECC412	Analog Electronic Circuits Laboratory	0	0	3	3	2
Total			**15**	**4**	**6**	**25**	**23**

3rdYear (Semester: V)							
Sl No.	Code No.	Subject	Contact Periods/Week				Credits
			L	T	P	Total	
Theoretical Papers							
1	ECC501	Communication - I	3	1	0	4	4
2	EEC501	Control System Engineering	3	1	0	4	4
3	ECC502	Microprocessor and Microcontroller Systems	3	0	0	3	3
4	HUC501	Humanities - IV (Organizational Behaviour)	3	0	0	3	3
Sessional Papers							
5	ECC511	Communication - I Laboratory	0	0	3	3	2
6	ECC512	Microprocessor and Microcontroller Systems Laboratory	0	0	3	3	2
7	HUC511	Soft Skill Development	0	0	3	3	2
8	ECC591	Project - I (A)	0	0	5	5	3
Total			**12**	**2**	**14**	**28**	**23**

3rdYear (Semester: VI)							
Sl No.	Code No.	Subject	Contact Periods/Week				Credits
			L	T	P	Total	
Theoretical Papers							
1	ECC601	Communication- II	3	1	0	4	4
2	ECC602	Digital Signal Processing	3	0	0	3	3
3	CSC601	Computer Networks	3	1	0	4	4
4	CSC602	Machine Learning	3	0	0	3	3
Sessional Papers							
5	ECC611	Communication - II Laboratory	0	0	3	3	2
6	ECC612	Digital Signal Processing Laboratory	0	0	3	3	2
7	CSC611	Computer Networks Laboratory	0	0	3	3	2
8	ECC691	Project - I (B)	0	0	5	5	3
Total			**12**	**2**	**14**	**28**	**23**

4th Year (Semester: VII)							
Sl No.	Code No.	Subject	Contact Periods/Week				Credits
			L	T	P	Total	
Theoretical Papers							
1	ECC701	VLSI Engineering	3	0	0	3	3
2	ECC702	RF and Microwave Engineering	3	1	0	4	4
3	ECE/CSE7XX	Elective - I	3	0	0	3	3
4	ECE/CSE7XX	Elective - II	3	0	0	3	3
Sessional Papers							
5	ECC711	VLSI Engineering Laboratory	0	0	3	3	2
6	ECC712	RF and Microwave Engineering Laboratory	0	0	3	3	2
7	ECC791	Project - II (A)	0	0	15	15	10
Total			**12**	**1**	**21**	**34**	**27**

4th Year (Semester: VIII)							
Sl No.	Code No.	Subject	Contact Periods/Week				Credits
			L	T	P	Total	
Theoretical Papers							
1	ECE/CSE8XX	Elective - III	3	0	0	3	3
2	ECE/CSE8XX	Elective - IV	3	0	0	3	3
3	ECE/CSE8XX	Elective - V	3	0	0	3	3
Sessional Papers							
4	ECC891	Project - II (B)	0	0	15	15	10
5	ECC892	Comprehensive Viva	0	0	0	0	3
Total			**9**	**0**	**15**	**24**	**22**

Total Program Credit	**(24+22+22+23+23+23+27+22)**	**186**

List of Elective Subjects

Sl. No.	Semester	Course Name	Course code	L-T-P	Credit
		CSE			
1		Logic & Reasoning	CSE721	3-0-0	3
2		Data Analytics & Optimization Techniques	CSE722	3-0-0	3
3		Ad-Hoc and Sensor Networks	CSE723	3-0-0	3
4		Mobile Computing	CSE724	3-0-0	3
5		Cyber Law and Security	CSE725	3-0-0	3
6		Computational Number Theory	CSE726	3-0-0	3
7	**Autumn**	Computational Complexity	CSE727	3-0-0	3
8		Computer Graphics and Multimedia	CSE728	3-0-0	3
9		Computational Geometry	CSE729	3-0-0	3
10		Computer Vision and Image Understanding	CSE730	3-0-0	3
11		Fuzzy Logic and Applications	CSE731	3-0-0	3
12		Mathematical Methods	CSE732	3-0-0	3
13		Neural Networks and Deep Learning	CSE733	3-0-0	3

14		Data Communications	CSE734	3-0-0	3
15		Digital Signal Processing	CSE735	3-0-0	3
		ECE			
1		Optical Communication	ECE721	3-0-0	3
2		Remote Sensing and GIS	ECE722	3-0-0	3
3		Modern Radar Systems	ECE723	3-0-0	3
4		Satellite Communication Systems	ECE724	3-0-0	3
5		Mixed-Signal and RF Design	ECE725	3-0-0	3
6		Principle of Nano-electronics and devices	ECE726	3-0-0	3
7		VLSI Technology	ECE727	3-0-0	3
8		Embedded System Design	ECE728	3-0-0	3
9		Fundamentals of RISC-V Processor Architecture and Design	ECE729	3-0-0	3
10		Antenna Engineering	ECE730	3-0-0	3
11		Wireless Communications	ECE731	3-0-0	3
		CSE			
1		Data Mining	CSE821	3-0-0	3

2		Speech and Natural Language Processing	CSE822	3-0-0	3
3		Soft Computing	CSE823	3-0-0	3
4		Big Data Analytics	CSE824	3-0-0	3
5		Coding Theory	CSE825	3-0-0	3
6		Distributed Operating Systems	CSE826	3-0-0	3
7		Distributed Database Management System	CSE827	3-0-0	3
8		Advanced Computer Architecture	CSE828	3-0-0	3
9		Fault Tolerant Computing	CSE829	3-0-0	3
10	**Spring**	Real Time Systems	CSE830	3-0-0	3
11		Robotics: Machines and Control	CSE831	3-0-0	3
12		Internet of Things	CSE832	3-0-0	3
13		Blockchain Technology	CSE833	3-0-0	3
14		Information Theory and Coding	CSE834	3-0-0	3
15		Advanced Cryptography	CSE835	3-0-0	3
16		Digital and Cyber Forensics	CSE836	3-0-0	3
17		Cyber Physical Systems	CSE837	3-0-0	3
18		Cloud Computing	CSE838	3-0-0	3

19		Parallel and Distributed Computing	CSE839	3-0-0	3
20		Quantum Computing	CSE840	3-0-0	3
21		Quantum AI	CSE841	3-0-0	3
22		Graph Theory and Applications	CSE842	3-0-0	3
23		Operation Research	CSE843	3-0-0	3
		ECE			
1		Multiple Input Multiple Output System	ECE821	3-0-0	3
2		Sensors and Instrumentation	ECE822	3-0-0	3
3		Adaptive Systems and Signal Processing	ECE823	3-0-0	3
4		CAD for VLSI	ECE824	3-0-0	3
5		Low power circuits and systems	ECE825	3-0-0	3
6		RF and Microwave Networks	ECE826	3-0-0	3
7		MEMs and Applications	ECE827	3-0-0	3
8		Biomedical System Engineering and Automation	ECE828	3-0-0	3
9		5G and Wireless Technology	ECE829	3-0-0	3
10		Integrated Nano photonics	ECE830	3-0-0	3

11		Mobile Communication and Fading	ECE831	3-0-0	3
12		Fiber Optics, Components and Devices	ECE832	3-0-0	3
13		Signal Theory	ECE833	3-0-0	3
14		RF CMOS Circuits	ECE834	3-0-0	3
15		CAD for VLSI	ECE835	3-0-0	3

Syllabus

for 4 years B. Tech. in

Electronics and Communication Engineering

1. SEMESTER – I

Course Title : MATHEMATICS – I (LINEAR ALGEBRA)
Course Code : MAC101
Weekly contact : 3 – 1 – 0 (L – T – P)
Credit : 4

Solving a linear system of equations:
Geometric (row) and algebraic (column) picture of matrix equations, Gaussian elimination, LU decomposition, pivoting, round-off errors, pivoting, matrix inverse and transpose, finite difference matrices – tridiagonal and their LU decomposition.

Vector spaces:

Definitions of vector spaces and sub-spaces, column and null space of a matrix with examples, echelon and row reduced echelon form of a matrix, matrix rank and dimensionality of col space and null space, span of a vector space, basis, dimension, four fundamental subspaces related to a matrix, inverses of rectangular matrices, linear transformations.

Orthogonality:

Orthogonality of vectors, subspaces, notion of orthogonal compliment of a subspace, and orthogonality relations between the four fundamental subspaces of a matrix, Solutions to least square error problems and connection to pseudo-inverse

Projection onto a vector space as a matrix operation, projection onto a line. Minimum norm solution in the under-determined case, and connection to pseudo-inverse. Orthogonal vector and matrices. Gram-Schmidt process of orthonormalization, QR decomposition of a matrix. Hilbert spaces, function spaces and the concept of orthogonality in these spaces

Determinants:

Properties of determinants, Geometrical interpretation of determinants, determinant of the Jacobian.

Eigenvalues and Eigenvectors:

Definition and properties of the matrix eigenvalue problem, Algebraic and geometric multiplicity of an eigenvalue, Diagonalization of a matrix and its use to compute powers of a matrix. Hermitian matrices and their properties, Spectral theorem, Unitary matrices. Change of basis and similarity transforms. Schur decomposition of a matrix.

Positive definite matrices and SVD:

Idea of optimization, quadratic forms, definition of and tests for positive definite matrices, geometric interpretations, Proof of the singular value decomposition. Properties of the Singular value decomposition SVD and matrix computations; psuedo-inverses, condition number, regularization.

Reference Books:

1. G. Strang, Introduction to Linear Algebra, Wellesley-Cambridge Press.
2. S. Lang, Linear Algebra, Springer.
3. S. Boyd, Introduction to Applied Linear Algebra, Cambridge University Press.

Course Title : PHYSICS

Course Code	**: PHC101**
Weekly contact	**: 3 – 1 – 0 (L – T – P)**
Credit	**: 4**

Introduction:
Review of Simple Harmonic Motion, Damped and Forced Oscillations, Resonance, Coupled Oscillations, Normal Modes.

Wave Motion:
Longitudinal and transverse waves, wave equation, plane waves, phase velocity, superposition, wave packets and group velocity, dispersion relations, two- and three-dimensional waves, polarisation.

Electromagnetic waves:
Maxwell's Equations, wave equation, plane electromagnetic waves, energy-momentum, Poynting's theorem, electromagnetic boundary conditions, reflection and refraction, Stokes relations.
Interference, Coherence, Young's experiment, interferometers, thin films, Fraunhofer Single Slit diffraction and Grating, dispersion, radiation.

Wave Mechanics
Failure of classical physics, review of experiments leading to wave mechanics, de Broglie waves, uncertainty principle, wave function and Schrodinger equation, probability interpretation, infinite square well, potential barrier and quantum tunnelling, qualitative summary of simple harmonic oscillator and Hydrogen atom.

Reference Books:

1. Crawford F.S. Waves, Vol. 3, Berkely Physics Series.
2. Goldstein, Classical Mechanics, Pole and Safko, Pearson Education Inc.
3. Saleh and Teich. Fundamentals of Photonics, Wiley-Interscience.
4. Griffiths D.J. Introduction to Quantum Mechanics, Pearson Education Inc.
5. Pain H. J. The Physics of Vibrations and Waves, Wiley.
6. Resnick R. Introduction to Special Relativity, John Wiley (Asia).
7. Landau L. and Lifshitz E. Mechanics, Oxford
8. Zweibach B. A First Course in String Theory, Cambridge University Press
9. Hecht E. Introduction to Optics, Addison-Wesley.
10. Feynmann Lecture series on Physics.
11. Sakurai J. J. Modern Quantum Mechanics, Benjamin-Cummings.
12. Beiser, Mahajan and Chowdary, Concepts of Modern Physics

Course Title : BASIC ELECTRICAL AND ELECTRONICS ENGINEERING
Course Code : ECC101
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

DC Network Theorem:

Definition of electric circuit network; linear circuit, non-linear circuit, bilateral circuit, unilateral circuit; Source: AC, DC, average and RMS values, peak factor, form factor; Dependent source; Kirchhoff's law, Principle of superposition; Source equivalence and conversion; Thevenin's theorem, Norton Theorem, nodal analysis, mesh analysis, star-delta conversion; Maximum power transfer theorem with proof.

Semiconductors Diode:

Conductors, Semiconductors and Insulators: electrical properties, band diagrams. Fermi levels; Semiconductors: intrinsic and extrinsic, energy band diagram, P-type and N-type semiconductors. Formation of P-N junction, energy band diagram, built-in-potential; Forward and Reverse biased P-N junction, formation of depletion zone, V-I characteristics, Avalanche breakdown and its reverse characteristics; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency; Filters and Regulators: Capacitor filter, π-section filter, Zener diode, idea of regulation.

Bipolar Junction Transistors:

Formation of PNP / NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, transistor action, current amplification factors for CB and CE modes.

Biasing and Bias stability: Transistor Biasing and Stability: Q-point, Self Bias-CE, calculation of stability factor; Compensation techniques.

Feed Back Amplifier, Oscillators:

Concept (Block diagram), properties, positive and negative feedback, loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, output impedance, input impedance, sensitivities (qualitative), bandwidth stability; effect of positive feedback: instability and oscillation, condition of oscillation, Barkhausen criteria.

Operational Amplifier:

Ideal OPAMP, Differential Amplifier, CMRR, Open & Closed loop circuits, inverting & noninverting amplifiers, voltage follower/buffer circuit. Applications of Operational Amplifiers: adder, integrator & differentiator, comparator, Log & Anti-log amplifiers, voltage to current and current to voltage converter.

Reference Books:

1. D Chattopadhyay and P.C. Rakshit, Electronics Fundamentals and Applications, New Age International Publications.
2. Malvino—Electronic Principles, 6/e , McGraw Hill
3. Boylested & Nashelsky- Electronic Devices and Circuit Theory-Pearson/PHI
4. Sedra & Smith-Microelectronic Circuits- Oxford UP

Course Title : PROGRAMMING -I (C LANGUAGE)
Course Code : CSC101
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

Introduction

Introduction to Computer, Input & Output devices, Computer memory and Processor, Computer Software and Computer Networks, Number System, Computer code and Boolean Algebra

Introduction to C

The language of C: Phases of developing and running computer program in C, Simple C programs, C Tokens, Keywords, Identifiers, Data types, Constants, Variables, Operators and I/O statements

Loops and conditionals

Control statements, Conditional branching statements (if, if-else, if-else-if, switch), Iterative statements (for, while, do-while), Nested loops, Break, Continue, and Goto statements.

Functions

Function declaration, Function definition, Function call (call-by-value, call-by-reference), Recursive function, Storage classes, and Scope of variables.

Arrays

Array (1D array, 2D array, 3D array and multi-dimensional) declaration, Operations on array, Searching and Sorting, Passing arrays to functions, String representation, Operation on strings, Different string manipulation function.

Pointers

Pointer variables, pointer arithmetic, pointers with arrays, pointers with strings, pointers with functions, pointers to pointers, and dynamic memory allocation.

Structure and Union

User-defined data types- structure and unions (declaration, initialization and access), nested structures, use of structures and unions with pointers, arrays, functions.

File Handling

File handing in C, opening a file, closing a file, reading of data from a file, writing data to a file, error handling.

Pre-processor Directives

C pre-processor directives, C Libraries.

Reference Books:

1. Brian W. Kernighan, The C Programming Language, Prentice Hall.
2. Y. P. Kanetkar, Let Us C: Authentic Guide to C PROGRAMMING Language
3. R. Thareja, Computer Fundamentals and Programming in C. 2nd Edition, Oxford University Press.
4. J.R. Hanly and E.B. Koffman, Problem Solving and Program Design in C. 5th Edition. Pearson Education
5. Y. Patt, S. Patel. Introduction to Computing Systems: From bits & gates to C & beyond, 2nd Edition, McGraw Hill

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Course Title : ENGLISH FOR COMMUNICATION
Course Code : HUC101
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

Writing Skill:

Paragraph Writing, Commercial Correspondence, Précis, Preparing Instruction Manuals, Preparing Proposals, Report Writing, Writing of Dissertation/Thesis, Elements of Grammas and Vocabulary.

Oral communication:

Group Discussion; Extempore Speaking; Presentation Strategies; Interview Preparation.

This course seeks to develop a sense of language through texts drawn from contemporary writings in newspapers, news magazines, reports, etc.

Reference Books:

1. Oxford Book of Writing and Speaking - Peter Seeley
2. Technical Communication Principles and Practice, Meenakshi Raman & Sangeeta Sharma

Course Title	**: HUMANITIES - I (VALUES & ETHICS IN PROFESSION)**
Course Code	**: HUC102**
Weekly contact	**: 3 – 0 – 0 (L – T – P)**
Credit	**: 3**

Introduction

Definition of Science, Technology, Engineering and Ethics. Relationship between the science, technology and Ethics, Different types of Ethics, Dimensions of Ethics, Essence of Ethics, Approaches to Ethical study as Indian Perspective and western perspective, basic concepts of ethics, morality and value, Virtue Ethics, Ethics in public life, ethics in engineering, Ethics in work place. Definition and characteristic of profession.

Effects of Technological growth and various Engineering Activities

Resource Depletion: Club of Rome, Objectives of Club of Rome, Sustainable Development.

Energy Crisis: History, cause and effect, National and international Case studies.

E.f. Schumacher's Appropriate Technology Movement (ATM): Influential factors, advantages and disadvantages of ATM, Case studies National and International.

Environmental Ethics: Pollution, contributions of engineers in eradicating/ reducing pollution, Government's measures

Man-Machine Interaction: Emotional Intelligence and ethics, AI and Ethics, Robotics and Brain Computer interface.

Ethical and Social Responsibilities of an Engineer:

Engineering as Experimentation – Engineers as responsible Experimenters – Safety Engineering- Codes of Ethics – A Balanced Outlook on Law.

Human values and Good Life:

Lessons from the lives and teachings of great leaders, reformers and administrators; role of family, society and educational institutions in inculcating value, , Freedom and discipline, Duties and rights, Contribution

of Family in Value education, Contribution of society in inculcating values, Role of educational institutions in inculcating values.
Value crisis in modern day world and a way out- Components of a Good Life- Psychological values, Aesthetic values, Moral and Ethical Values , Material values, Spiritual Values, Social values- Values of Indian Constitution, Democracy, Secularism, Fundamental Rights.

Reference Books:

1. Professional Ethics and Human Values by R.S NAAGARAZAN
2. Engineering Ethics Fourth Edition by CHARLES B. FLEDDERMANN

Course Title : PROGRAMMING -I (C LANGUAGE) LABORATORY
Course Code : CSC111
Weekly contact : 0 – 0 – 3 (L – T – P)
Credit : 2

C program implementation on following topics

Familiarization with programming environment

1. Familiarization with C editors in Linux (vi, gedit, nano etc.)
2. Familiarization with C compiler (different options of gcc)
3. Write simple program in C and generate the output

Data types in C

1. Write C simple programs with using data types, constants and display the results.
2. Write interactive programs which can take user input and display output in using different format specifiers

Loops and conditionals

1. Write programs using conditional statements (if-else, switch case)
2. Write programs using loops (for, while, do).

Functions

1. Write programs with functions
2. Pass variables to functions using call by value
3. Write recursive function to compute factorial of a number, sum of n numbers, Fibonacci series etc.

Arrays

1. Write programs using array (1D array, 2D array, 3D array and multi-dimensional) and perform operations on array
2. Write programs using strings and perform string
3. Write program to perform searching in array
4. Write program to implement simple sorting algorithm (e.g bubble sort)

Pointers

1. Familiarization with pointer implementation in C
2. Write program with function call using call by reference

Structure and Union

1. Write program using Structure
2. Use functions to store user given data in structure and union and display output after computation

File Handling

1. Familiarization with file handling in C
2. Write programs using text and binary files

Preprocessor Directives

Familiarization with preprocessor directives and C libraries

Reference Books:

1. Brian W. Kernighan, The C Programming Language, Prentice Hall.
2. Y. P. Kanetkar, Let Us C: Authentic Guide to C PROGRAMMING Language
3. R. Thareja, Computer Fundamentals and Programming in C. 2nd Edition, Oxford University Press.
4. J.R. Hanly and E.B. Koffman, Problem Solving and Program Design in C. 5th Edition. Pearson Education
5. Y. Patt, S. Patel. Introduction to Computing Systems: From bits & gates to C & beyond, 2nd Edition, McGraw Hill

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Course Title	**: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY**
Course Code	**: ECC111**
Weekly contact	**: 0 – 0 – 3 (L – T – P)**
Credit	**: 2**

List of Experiments:

1.Familiarization with Electronic Components and Instruments
2. To verify Superposition Theorem
3. To verify Thevenin's and Norton's Theorem
4. Study of V-I Characteristics of p-n Diode and Zener Diode under forward and reverse bias
5. Study on Half wave rectifier
6. Study on Full wave rectifier
7. Study the output characteristics curves for BJT common emitter(CE) mode
8. Study of OPAMP circuits: Inverting and Non-Inverting amplifiers

Reference Books:

1.D Chattopadhyay and P.C. Rakshit, Electronics Fundamentals and Applications, New Age International Publications.
2.Malvino—Electronic Principles, 6/e , McGraw Hill
3.Boylested & Nashelsky- Electronic Devices and Circuit Theory- Pearson/PHI

2. SEMESTER – II

Course Title	**: MATHEMATICS – II (PROBABILITY AND STATISTICS)**
Course Code	**: MAC201**
Weekly contact	**: 3 – 1 – 0 (L – T – P)**
Credit	**: 4**

Probability:

Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes Theorem and independence

Random Variables:

Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, moment generating function, Chebyshev's inequality

Special Distributions:

Discrete uniform, Binomial, Geometric, Poisson, Exponential, Gamma, Normal distributions
Functions of a Random Variable

Joint Distributions:

Joint, marginal and conditional distributions, product moments, correlation, independence of random variables, bivariate normal distribution

Statistics

Sampling Distributions, Distribution of Mean, Chi Square Distribution, t distribution, Hypothesis Testing, Goodness of fit, Regression and Correlation, Method of least squares, linear regression

Reference Books:

1. John E. Fruend's Mathematical Statistics, 6th Edition by Irwin Miller and Marylees Miller.
2. M.A. Berger, An Introduction to Probability and Stochastic Processes, Springer.
3. I. Florescu, Probability and Stochastic Processes, O'Reilly.
4. E. Bas, Basics of Probability and Stochastic Processes, Springer.
5. K. Najim, E. Ikonen, A.K. Daoud, Stochastic Processes, Elsevier.
6. An Introduction to Probability and Statistics by V.K. Rohatgi & A.K. Md.E.Saleh.
7. Introduction to Probability and Statistics by J.S. Milton & J.C.Arnold.
8. Introduction to Probability Theory and Statistical Inference by H.J. Larson.
9. Introduction to Probability and Statistics for Engineers and Scientists by S.M. Ross
10. A First Course in Probability by S.M. Ross
11. Probability and Statistics in Engineering by W.W. Hines, D.C. Montgomery, D.M. Gpldsman & C.M.Borror

Course Title : PHYSICS - II
Course Code : PHC201
Weekly contact : 3 – 1 – 0 (L – T – P)
Credit s : 4

Module I: Wave nature of particles and the Schrodinger equation

Introduction to Quantum mechanics, Wave nature of Particles, Time-dependent and time independent Schrodinger equation for wave function, Born interpretation, probability current, Expectation values, Free-particle wave function and wave-packets, Uncertainty principle.

Module II: Mathematical Preliminaries for quantum mechanics

Complex numbers, Linear vector spaces, inner product, operators, eigenvalue problems, Hermitian operators, Hermite polynomials, Legendre's equation, spherical harmonics.

Module III: Applying the Schrodinger equation

Solution of stationary-state Schrodinger equation for one dimensional problems – particle in a box, particle in attractive delta-function potential, square-well potential, linear harmonic oscillator. Numerical solution of stationary-state Schrodinger equation for one dimensional problems for different potentials Scattering from a potential barrier and tunnelling; related examples like alpha-decay, field ionization and scanning tunnelling microscope, Three dimensional problems: particle in three dimensional box and related examples, Angular momentum operator, Rigid Rotor, Hydrogen atom ground-state, orbitals, interaction with magnetic field, spin, Numerical solution stationary-state radial Schrodinger equation for spherically symmetric potentials.

Module IV: Introduction to molecular bonding

Particle in double delta-function potential, Molecules (hydrogen molecule, valence bond and molecular orbitals picture), singlet/triplet states, chemical bonding, hybridization.

Module V: Introduction to solids

Free electron theory of metals, Fermi level, density of states, Application to white dwarfs and neutron stars, Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands, Numerical solution for energy in one-dimensional periodic lattice by mixing plane waves.

TEXTBOOKS/REFERENCES:

1. Eisberg and Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, Wiley Publications, 2nd Edition.
2. David. J. Griffiths, and Darrell F. Schroeter, Introduction to Quantum mechanics, Cambridge University Press, 3rd Edition.
3. Richard W. Robinett, Quantum Mechanics, OUP Oxford; 2nd edition.
4. Daniel McQuarrie, Quantum Chemistry, University Science Books; 2nd edition.

Course Title : DIGITAL LOGIC DESIGN AND CIRCUIT
Course Code : ECC201
Weekly contact : 3 – 0 – 0 (L – T – P)

Credit : 3

Number System:
Binary numbers, decimal, Octal & Hexadecimal Numbers, Number Base Conversion, 1's & 2's Complements, Binary arithmetic, Binary codes.

Boolean algebra & Logical Gates:
Basic Definitions, Boolean Algebra Theorems of Boolean Algebra, Boolean Functions, Digital Logic Gates, SOP, POS, Minterms, Maxterms, Simplification of Boolean functions: algebraic method, Karnaugh maps.

Combinational Logic Circuits
Half and Full adder, Half and Full subtractor, Parallel Adder, CLA, Code conversion circuit, Decoder, Encoder, Multiplexer, De- Multiplexer.

Sequential logic circuits:
Different flip flops and latches, Registers, Asynchronous and Synchronous counters. Finite state machine, State transition diagrams and state transition tables.

Memory elements:
ROM, PROM, RAM-SRAM, DRAM. PLA, PLD, FPGA

Analog-to-digital Converter

Digital-to-analog data converters

Concept of programmable processors and microcontrollers.

Case studies: a simple computer, instruction coding and decoding, timing and controller circuits.

Reference Books:
3. Digital Electronics by Morris Mano
4. Digital Electronics by Salivahanan
5. Fundamental of Digital Circuits by A. Anand Kumar

Course Title : DATA STRUCTURES AND ALGORITHMS
Course Code : CSC201
Weekly contact : 3 – 1 – 0 (L – T – P)
Credit : 4

Introduction

Introduction, objective, motivation. Definition of Data Structure, Classification of Data Structures, Operations on Data Structures

Algorithm and Asymptotic Analysis

Algorithm: Definition, Time Complexity, Space Complexity

Basic Data Structures and Applications

Arrays, Strings, Pointers, Structures ,
Singly Linked List: Traversal, Searching, Insertion, and Deletion.
Circular Linked List: Insertion, and Deletion. Doubly Linked List: Insertion, and Deletion. Circular Doubly Linked List: Insertion, and Deletion
Applications: Use of Linked List, Polynomial Representation of Linked List
Stack: Array Representation, Operations on a Stack (Push, Pop), Linked Representation of Stack, Operations on a Linked Stack
Applications of Stack: Evaluation of Arithmetic Expressions, Recursion: Factorial function, Towers of Hanoi
Queue: Array Representation, Linked Representation, Circular Queue, Deque, Priority Queues

Sorting

Sorting: Bubble Sort, Insertion Sort, Selection Sort, Merge Sort, Quick Sort, and Heap Sort

Tree

Tree: Binary Tree, Binary Search Tree, Creating a Binary Tree from a General Tree. Traversing a Binary Tree: Pre-order, In-order and Post-order Traversal, Huffman's Tree and Application.

Searching

Searching Techniques: Linear Search, Binary Search. Operations on Binary Search Tree: Searching, Insertion, and Deletion. Determining the Height of a Binary Search Tree, Search the Smallest Node in a Binary Search Tree, Search the Largest Node in a Binary Search Tree, Threaded Binary Tree. AVL Tree, Operations on AVL Tree, Searching for a Node in an AVL Tree, Red-Black Tree, m-way Search Tree, B Tree, B+ Tree, 2-3 Tree, Binary Heap: Insertion, and Deletion, Binomial Heap, Fibonacci Heap

Graph

Graph: Directed Graph and Undirected Graph.

Representation of Graph: Adjacency Matrix.
Graph Traversal: Breadth-First Search and Depth-first Search.
Topological Sorting, Shortest Path Algorithms: Minimum Spanning Tree (Prim's Algorithm and Kruskal's Algorithm)

Hashing

Hashing: Definition, Hash Table, Hash Function.
Collision Resolution techniques: Open addressing and Chaining

Reference Books:

1. Seymour Lipschutz, Data Structures. Mc-Graw Hill Education.
2. Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, Data Structures Using C and C++. Pearson, 2nd Edition, 1996.
3. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Fundamentals of Data Structures in C. University Press.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms. Prentice Hall of India, 3rd ed., 2009

Course Title : HUMANITIES - II (ECONOMICS)
Course Code : HUC201
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

Point of Initiation – Central Concepts of Economics

Scarcity and efficiency – Goods: Use & Exchange Value – The three fundamental questions of economic organization – Micro & Macroeconomics – Positive v/s Normative economics – Circular flow of income – Market, command and mixed economies – Society's technological possibilities

Introducing Demand & Supply

Demand Function and demand Curve, determinants of demand – Individual & Market Demand – changes in demand – Marshallian Law of Demand & its exceptions – Demand Elasticities – Techniques of Demand Forecasting.
The Supply Function & Supply Curve – general principle and exception – changes in supply – Supply elasticity – Concept of Market equilibrium & impacts of changes in demand and supply – Revenue

Theory of Consumer Behaviour

Concept of Utility – Cardinal v/s ordinal utility – Law of Diminishing Marginal Utility – Tools of analysis: Axiomatic Approach of Consumer Behaviour – Indifference Curves & Budget Space/Line – Consumer Equilibrium – Income & Substitution effects – derivation of Demand Curve from Indifference curve analysis – Price Consumption Curve and Income Consumption Curve – Engel Curve – Giffens & Inferior Goods - Taxes & Subsidies

Production & Cost

Production Function – the technological relationship between inputs & output – Short Run & Long Run Production analyses – Production with single variable input (short run) – stages of production & concept of economic zone of production; Long run production and tools of analysis: Isoquants and Isocost line, Producer's Equilibrium with two variable inputs, Ridge Lines and economic region – Expansion Paths

Different concepts of Cost of production, Fixed & variable Costs, Short run & Long run costs – concept of Opportunity Cost – The short run and long run total, average and marginal cost curves and their relations – economies of scale and concept of Optimum Plant-size

Market Morphology

Market Equilibrium and the Rule of Profit-maximization – Concept of Profit – Financial Profit v/s Economic Profit – concepts of break-even & shut-down points; Types of markets & their characteristics – Perfect Competition and its short run & long run equilibrium – concepts of increasing, decreasing & constant cost industry; Monopoly – causes of monopoly – Natural Monopoly – measure of monopolistic power (Lerner's Index) – Short run and Long run equilibrium of Monopoly – Concepts of different types of monopoly pricing – Monopoly has no supply curve – Multi-plant Monopolist, Price-discriminating Monopolist – welfare costs of monopoly

Rudiments of Macroeconomics

Measurement of economic activity – National Income; Closed & Open economy - foreign trade and balance of payments; Inflation & Unemployment – Economic policies

Reference Books:

1. Economics, by P. Samuelson & W. Nordhaus, 19th Edn. Indian Adaption by Sudip Choudhury & Anindya Sen
2. Managerial Economics - by Peterson & Lewis
3. Managerial Economics - by Mansfield

4. Economics - Principles & Applications - by G. Mankiw
5. Micro Economic Theory - by G.S. Maddala
6. Macroeconomics - by R. T. Froyen

Course Title	**: DIGITAL LOGIC DESIGN AND CIRCUIT LABORATORY**
Course Code	**: ECC201**
Weekly contact	**: 0 – 0 – 3 (L – T – P)**
Credit	**: 2**

List of Experiments:

1. Basic Gates & Universal Gates
2. Simplification of Boolean Expression and realization using Universal Gates
3. Half/Full Adder and Subtractor circuits, Ripple and Look ahead Carry
4. Design of different Code converters
5. Realization of Combinational circuits for a given function
6. Encoder, Priority Encoder, Decoder circuits
7. Multiplexer/Demultiplexer circuits
8. Study of different Flip-flops
9. Design of Asynchronous Counters
10. Design of Synchronous Counter
11. Design of Shift Registers

Reference Books:

1. Morris Mano, Digital Logic and Computer Design, Pearson Education
2. S. Salivahanan and S Arivazhagan, Digital Circuits and Design, Oxford Higher Education

Course Title	**: DATA STRUCTURES AND ALGORITHMS LABORATORY**
Course Code	**: CSC211**
Weekly contact	**: 0 – 0 – 3 (L – T – P)**
Credit	**: 2**

C program implementation on following topics

Basic Data Structures and Applications

1. Familiarization with abstract data types
2. Write programs using array and linked list
3. Implement singly linked list: Traversal, Searching, Insertion, and Deletion.

4. Implement circular linked list: Insertion, and Deletion.
5. Implement doubly linked list: Insertion, and Deletion
6. Implement Polynomial Representation using Linked List, addition and subtraction of polynomials
7. Implement Stack using
    a. array representation, operations on a Stack (Push, Pop),
    b. linked list representation, operations on a Linked Stack
8. Implement evaluation of arithmetic expressions using stack,
9. Implement recursion: Factorial function, Towers of Hanoi
10. Implement queue using
    a. array representation, operation on queue (enqueue, dequeue)
    b. linked list representation,
    c. circular queue

Sorting

Implement sorting algorithms

1. Bubble Sort, Insertion Sort, Selection Sort
2. Merge Sort, Quick Sort, Heap Sort

Tree

1. Implement tree data structure
    a. Binary Tree, Binary Search Tree,
    b. Traversing a Binary Tree
        i. Pre-order, In-order and Post-order Traversal

Searching

1. Implement searching techniques
    a. Linear Search
    b. Binary Search
    c. Operations on Binary Search Tree: Searching, Insertion, and Deletion
    d. Search the smallest (largest) node in a Binary Search Tree

Graph

1. Familiarization with graph representation using Adjacency Matrix.
2. Implement graph traversal
    a. Breadth-First
    b. Depth-first

Hashing

Implement hash table and write function to compute hash function

Reference Books:

1. Seymour Lipschutz, Data Structures. Mc-Graw Hill Education.
2. Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, Data Structures Using C and C++. Pearson, 2nd Edition, 1996.
3. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Fundamentals of Data Structures in C. University Press.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms. Prentice Hall of India, 3rd ed., 2009

6. SEMESTER – III

Course Title	**: MATHEMATICS-III (CALCULUS AND DIFFERENTIAL EQUATIONS)**
Course Code	**: MAC301**
Weekly contact	**: 3 – 1 – 0 (L – T – P)**
Credit	**: 4**

Differential Calculus (Functions of one Variable):
Rolle's theorem, Cauchy's mean value theorem (Lagrange s mean value theorem as a special case), Taylor's and Maclaurin's theorems with remainders, indeterminate forms, concavity and convexity of a curve, points of inflexion, asymptotes and curvature.

Differential Calculus (Functions of several variables):
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 and their commutativity, Euler's theorem on homogeneous functions, harmonic

functions, Taylor's expansion of functions of several variables, maxima and minima of functions of several variables - Lagrange's method of multipliers

FIRST ORDER ODEs

Introduction to DE, Order of DE, First Order ODE F (x, y, y') = O.
Concept of solution (general solution, Particular solution, implicit solution etc.), Geometrical interpretations (direction fields, isoclines), orthogonal trajectories, Separable form, Reduction to separable form, Exact equations, Integrating factors [of the form F(x) and F(y)], Linear equations, Bernoulli equation, Picard's existence and uniqueness theorem (without proof), Picard's iteration method, Numerical methods: Euler's method, improved Euler's method.

SECOND ORDER ODEs

Homogeneous Linear ODEs of Second Order: Fundamental system and general solutions of homogeneous equations, reduction of order.
Homogeneous Linear ODEs with Constant Coefficients: Characteristic equations, real distinct roots, complex roots, repeated roots. Differential Operators. Euler-Cauchy equation, Existence and Uniqueness of Solutions, Linear Dependence and Independence of Solutions: Wronskian, Non-homogeneous equations: Method of undetermined coefficients, Solution by Variation of Parameters, Extension to higher order differential equations,

SERIES SOLUTIONS OF ODEs & SPECIAL FUNCTIONS

Power series Solutions: ordinary points (Legendre equation).
Legendre's Equation & Legendre Polynomials Pn(x)
Extended Power Series Method: Frobenius Method
Bessel's Equation & Bessel Functions Jn(x)

LAPLACE TRANSFORMS

Laplace and inverse Laplace transforms, first shifting theorem, existence and uniqueness of Laplace transform.
Laplace transforms of derivatives and integrals, Solving ODEs with Laplace Transform.
Unit step function, second shifting theorem, Dirac Delta Function/Unit Impulse Function
Convolution and Applications (Initial Value Problems)
Differentiation and Integration of Transforms

Reference Books:

1. Advanced Engineering Mathematics, E. Kreyzig, 10th Edition, Wiley.
2. M.D.Weir, J. Hass, F.R. Giordano, Thomas Calculus, 11th Edition, Pearson Education
3. J. Stewart, Essential Calculus, Thomson (2003).
4. Deborah Hughes-Hallett, Andrew M. Gleason, William G. McCallum – Calculus Multivariable Wiley (2017)

5. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Edition, Wiley India, 2005.
6. S. L. Ross, Introduction to Ordinary Differential Equations, 4th Edition-Wiley, 1989.
7. G. F. Simmons, Differential equations with applications and historical notes, Chapman and Hall_CRC, 2017

Course Title	**: SIGNALS AND SYSTEMS**
Course Code	**: ECC301**
Weekly contact	**: 3 – 1 – 0 (L – T – P)**
Credit	**: 4**

Time-domain characterization of signals and systems:
Definition of a signal, useful signal operations (time shifting, scaling, reversal and combined operations), classification of signals (continuous-time and discrete-time signals, analog and digital signals, periodic and aperiodic signals, energy and power signals, deterministic and random signals). Useful signals of interest (unit step, Impulse, Ramp, Sinc, Triangle, Rect.), even and odd signals with properties, sifting property of the Dirac-Delta function. Definition of a system, classification of systems (linear and non-linear Systems, time-invariant and time-varying systems, static and dynamic systems, causal and non-causal systems, continuous-time and discrete-time systems, invertible and non-invertible systems, stable and unstable Systems)

Linear Time Invariant (LTI) Systems:
Evolution of the convolution integral/sum, properties of convolution integral/ sum, Impulse Response of an LTI system, causality, stability, invertibility of LTI systems using impulse response

Fourier Analysis:
Fourier Series (for both continuous-time and discrete-time signals): Expressing a periodic signal as a linear combination of harmonically-related sinusoids or complex exponentials, orthogonality of the Fourier basis, concept of orthogonal projections for evaluating Fourier Series coefficients, brief discussion of convergence issues and conditions for existence of the Fourier Series, properties of the Fourier Series, Parseval's Theorem. Distinction between continuous-time and discrete-time Fourier Series.

Fourier Transform (for both continuous-time and discrete-time signals): Expressing aperiodic signals as a linear combination of complex exponentials with a continuum in frequency, convergence issues and existence of Fourier Transform, distinction between continuous-time and discrete-time Fourier Transforms, properties of Fourier Transform, Parseval's Theorem, study of interaction between signals and LTI systems using Fourier analysis

Sampling Theorem:
Sampling Theorem with proof, signal reconstruction

Laplace Transform:
Unilateral and Bi-lateral Laplace Transform, Region of Convergence, properties of Laplace Transform, inverse Laplace Transform, analysis of continuous-time LTI systems using the Laplace Transform

Z-Transform:
Introduction to Z-Transform, Properties of Z-Transform, Region of Convergence, Inverse z-Transform, analysis of discrete-time LTI systems using the Z-Transform

Reference Books:

1. Signals and Systems - A.V. Oppenheim, by A.S. Willsky and S.H. Nawab
2. Principles of Linear Systems and Signals, by B. P. Lathi
3. Signals and Systems, by Hwei P. Hsu

Course Title : SEMICONDUCTOR DEVICES
Course Code : ECC302
Weekly contact : 3 – 1 – 0 (L – T – P)
Credit : 4

Fundamentals of Semiconductor:
Crystal structure, Direct and indirect semiconductor, Variation of energy band with alloy composition, III-V and II-VI alloy semiconductor, Homo and hetero structure semiconductor, Effective masses of carriers in semiconductor, Fermi-Dirac distribution function, Density of states, Carrier concentrations at equilibrium, Calculation of number density of carriers and their temperature dependence, Effects of temperature on carrier concentrations, High field effects, scattering and drift of electrons and holes, drift current, diffusion mechanism, generation and recombination and injection of carriers, transient response, basic governing equations in

semiconductor, Hall effect, Lithography, Optical lithography and Electron beam lithography.

Junction-Diodes:
P-N junction, Contact potential, Band diagram, Transport equations, current and voltage characteristics and temperature dependence, Tunnelling current, small signal ac analysis, Degenerate semiconductors, Schottky diode, Ohmic contact, Rectifying contact.

BJT equivalent circuits:
Modelling frequency response of transistors, pnpn diode, SCR.

MOSFET device:
MOS Capacitor, Flat-band threshold voltages, Accumulation, Inversion, strong inversion regions, Capacitance-voltage characteristics at low and high frequencies, MOSFET device structure, Transfer and output characteristics, Small signal analysis, MOSFET as an amplifier and a switch, Transconductance, CMOS IC technology, CMOS latch-up phenomenon.

Optical absorption in a semiconductor:
Photovoltaic effect, solar cell, photoconductors, PIN photodiode, avalanche photodiode, LED, semiconductor lasers.

Special devices:
Negative conductance in semiconductors, transit time devices, IMPATT, Gunn device, Charge Coupled Devices (CCD).

Reference Books:
1. Solid State Electronic Devices, Ben G Streetman & Banerjee
2. Semiconductor Physics and Devices, Donald A.Neamen
3. Microwave Solid-State Devices, S Y Liao
4. Integrated Electronics, Millman-Halkias
5. Physics of Semiconductor Devices, S M SZE

Course Title : COMPUTER ORGANISATION AND ARCHITECTURE
Course Code : CSC301
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

Basic Functional Blocks of a Computer:
CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU - registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study - instruction sets of some common CPUs.

Data representation
Signed number representation, fixed and floating point representations, character representation.

Computer arithmetic
Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication - shift-and-add, Booth multiplier, carry save multiplier, etc. Division - restoring and non-restoring techniques, floating point arithmetic.

CPU Control Unit Design
Hardwired and micro-programmed design approaches, Case study - design of a simple hypothetical CPU.

Memory System Design
Semiconductor memory technologies, memory organization

Peripheral Devices:
Input-output subsystems, I/O transfers - program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes - role of interrupts in process state transitions.

Performance Enhancement Techniques
Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.

Memory Organization
Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

Reference Books:
1. Mano, M.M., "Computer System Architecture", PHI.
2. Behrooz Parhami "Computer Architecture", Oxford University Press

Course Title : HUMANITIES – III (PSYCHOLOGY)
Course Code : HUC301
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

Basic psychological processes and development:
Scope and Methods of Psychology – Biological basis of behaviour

Cognitive Processes:
(a) Sensation: attributes of sensation, Psychophysics (Weber – Fechner Law), Methods of Psychophysics
(b) Attention: determinants of attention, fluctuation of attention, selectivity of attention

(c) Perception: Movement, space, depth and time perception, perceptual organization, Gestalt View

Learning: Conditions of learning:
(a) Theory of classical conditioning
(b) Theory of operant conditioning
(c) Trial and error theory
(d) Theory of insight learning
(e) Programmed learning

Memory: Encoding, storage, retrieval:
(a) Types of memory (STM & LTM, Iconic, Echoic and Procedural)
(b) Forgetting curve
(c) Theories of forgetting

Motivation and Emotion:
Physiological and psychological basis of motivation and emotion
(a) Intrinsic and extrinsic motivation – factors of influencing intrinsic motivation
(b) Theories of motivation – Maslow, Maclelland
(c) Theories of emotion – James-Lange Theory, Canon-Bard and Schachter-Singer Theory
(d) Effects of motivation and emotion on behaviour

Intelligence
(a) Spearman's two factor theory
(b) Thursetone's theory
(c) Guilford's structure of intellect
(d) Gardner's theory
(e) Measurement of intelligence – IQ and deviation IQ, Tests of intelligence – Stanford Binet
(f) Types of intelligence – Social, abstract, concrete, emotional, artificial,
(g) Gifted and mentally challenged children

Thinking
(a) Piaget's theory of cognitive development – Problem solving
(b) Creative thinking – Nature and stages

Application of Psychology in different fields
(a) Rehabilitation
(b) Entrepreneurship and economic development
(c) Psychosocial problems of teenage and old age

Reference Books:
1. Baron, R. &Misra.G. (2013).Psychology. New Delhi: Pearson.

2. Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. (2001). Introduction to Psychology (7th Edition), McGraw Hill Booh Company.
3. Munn, N. L., Fernald, L. D., & Fernald, P. S.(2007). Introduction to Psychology (5th Edition). A.I.T.B.S Publishers India (ref)
4. Kenneth S. Bordens, Bruce B. Abbott. Research design and methods: a process approach 8th ed.
5. Levinthal, C.F. (2005). Introduction to Physiological Psychology, 3rd Edition, Prentice -Hall of India Pvt. Ltd., New Delhi.
6. Breedlove, S. M., Rosenzweig, M. R., & Watson, N. V. (2007) Biological Psychology: An introduction to behavioral, cognitive, and clinical neuroscience, 5th Edition. Sinauer Associates, Inc., Sunderland, Massachusetts. (Reference Book)

Course Title : SEMICONDUCTOR DEVICES LABORATORY
Course Code : ECC312
Weekly contact : 0 – 0 – 3 (L – T – P)
Credit : 2

List of Experiments:

1. Study of p-n junction diode characteristics under forward and reverse biased condition
2. Study of Zener diode characteristics and voltage regulator
3. Capacitance -Voltage Characteristics of a PN Junction (Doping profile)
4. Silicon Controlled Rectifiers (SCR) characteristics
5. I_D-V_{DS} characteristics of MOSFET
6. Clipper and Clampers circuits
7. Extraction of MOSFET LEVEL (1,2,3 and 6) SPICE parameters related to transfer (Id vs. Vg) characteristics
8. Extraction of MOSFET LEVEL (1,2,3 and 6) SPICE parameters related to output (Id vs. Vd) characteristics

*Extra: Fabrication lab visit at JU if possible

Some of these experiments can be executed using Silvaco TCAD in simulation level and others by bread broad in circuit level

Course Title : COMPUTER ORGANISATION AND ARCHITECTURE LABORATORY
Course Code : CSC311
Weekly contact : 0 – 0 – 3 (L – T – P)
Credit : 2

List of Experiments:

Reference Books:

SEMESTER – IV

Course Title : CIRCUIT THEORY
Course Code : ECC401
Weekly contact : 3 – 1 – 0 (L – T – P)
Credit : 4

Overview of Signals and Systems:
Continuous and discrete, fixed & time-varying, linear and non-linear, lumped and distributed, passive and active networks and systems. Concept of

dependent and independent sources. Signal types: step, ramp, impulse, sinusoidal, square, sawtooth signals. LTI systems, concept of impulse and step response of systems

Network Theorems:
Formulation of network equations, source transformation, mesh analysis, nodal analysis. Network theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Tellegen and reciprocity theorems. Star-delta transformations. Solution to numerical problems.

Coupled Circuits
Magnetic coupling, polarity of coils, polarity of induced voltage, concept of self and mutual inductance, coefficient of coupling, modelling of coupled circuits. Solution to numerical problems

Time-Domain and Frequency-Domain Methods for Circuit Analysis
Transient and steady-state analysis of electrical circuits having energy storing elements using differential equation approach. Steady-state analysis of circuits having energy storing elements and sinusoidal excitations with Phasors. Application of Laplace Transform for circuit analysis. Initial and Final value theorems. Solution to numerical problems with arbitrary waveform sources. Application of Fourier Series/Transform in circuit analysis

Application of Graph Theory in Circuit Analysis:
Concept of tree, branch, incidence matrix, tie-set matrix and loop currents, cut-set matrix and node pair potentials. Duality, solution to numerical problems

Two Port Networks:
Open-circuit impedance and short-circuit admittance parameters, transmission parameters, hybrid parameters and their inter relations. Concept of driving point impedance and admittance. Bartlett's bisection theorem and concept of lattice. Solution to numerical problems

Filters:
Analysis and synthesis of low-pass, high-pass, band-pass, band-reject, all-pass filters (first and second orders only). Solution to numerical problems

Reference Books:
1. Network Analysis and Synthesis by Franklin F. Kuo

2. Engineering Circuit Analysis by Hayt, Kemmerly, Phillips, Durbin
2. Network Analysis by M. E. Van Valkenburg
3. Network Analysis and Synthesis by S. P. Ghosh and A. Chakraborty

Course Title : ANALOG ELECTRONIC CIRCUITS
Course Code : ECC402
Weekly contact : 3 – 1 – 0 (L – T – P)
Credit : 4

Introduction:
Scope and applications of analog electronic circuits

Transistor Biasing and Stability:
Q-point, Self-Bias-CE, Compensation techniques, h-model of transistors. Expression for voltage gain, current gain, input and output impedance, trans-resistance & trans-conductance; Emitter follower circuits, High frequency model of transistors, Current mirror, Darlington pair.

Power Amplifier:
Frequency response of single stage and multistage amplifiers, Cascode amplifier, Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues, Transistor Amplifiers: RC coupled amplifier, functions of all components, derivation of voltage gain, current gain, input impedance and output impedance, frequency response characteristics, lower and upper half frequencies, bandwidth

Applications of Operational Amplifiers:
Adder, subtractor, integrator & differentiator, comparator, SchmittTrigger. Log & Anti-log amplifiers, Precision Rectifier, voltage to current and current to voltage converter.

Multivibrator:
Monostable, Bistable, Astable multivibrators; Monostable and astable operation using 555 timers.

Oscillators:
Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Collpit, Clapp etc.), non-sinusoidal oscillators

Regulators:
Series and shunt voltage regulator, percentage regulation, 78xx and 79xx series, concept of SMPS.

Reference Books:

1. Sedra & Smith-Microelectronic Circuits- Oxford UP
2. Franco—Design with Operational Amplifiers & Analog Integrated Circuits , 3/e, McGraw Hill
3. Boylested & Nashelsky- Electronic Devices and Circuit Theory- Pearson/PHI
4. Millman & Halkias – Integrated El;ectronics, McGraw Hill.
5. Rashid-Microelectronic Circuits-Analysis and Design- Thomson (Cenage Learning)
6. Schilling & Belove—Electronic Circuit:Discrete & Integrated , 3/e , McGraw Hill
7. Razavi- Fundamentals of Microelectronic s- Wiley
8. Malvino—Electronic Principles, 6/e, McGraw HillBehzad Razavi, Design of Analog CMOS Integrated Circuits, Tata McGraw-Hill

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Course Title : ELECTROMAGNETIC ENGINEERING
Course Code : ECC403
Weekly contact : 3 – 1 – 0 (L – T – P)
Credit : 4

Vector Analysis:

Vector Algebra: Scalars and Vectors, Unit Vector, Vector Addition and Subtraction, Position and Distance Vectors, Vector Multiplication, Components of a Vector; Coordinate Systems: Cartesian (or Rectangular) Coordinate System, Circular Cylindrical Coordinate System, Spherical Coordinate System; Vector Calculus: Differential Length, Area and Volume, Line, Surface and Volume Integrals, Del Operator, Gradient of a Scalar, Divergence of a Vector and Divergence Theorem, Curl of a Vector and Stokes's Theorem, Laplacian of a Scalar.

Electrostatics:

Electrostatic Fields: Coulombs Law, Electric Field (or Electric Field Intensity), Electric Field due to Continuous Charge Distribution, Electric Flux Density, Electric Flux, Gauss's Law for Electrostatic Fields (Maxwell's Equation), Applications of Gauss's Law, Electric Potential, Relationship Between E and V (Maxwell's Equation), Electric Dipole and Electric Dipole Moment, Electric Flux Lines (or Electric Lines of Force), Energy Stored and Energy Density in Electrostatic Fields; Electric Field in Material Space: Properties of Materials, Convection and Conduction Currents, Conductors, Polarization in Dielectrics, Dielectric Constant and Strength, Linear, Isotropic and Homogeneous Dielectrics, Continuity Equation and Relaxation Time, Electric Boundary Conditions; Electrostatic Boundary-Value Problems: Poisson's and Laplace's Equations, Uniqueness Theorem, General Procedures for Solving Poisson's or Laplace's Equation, Resistance, Capacitors and Capacitances, Method of Images (or Image Method or Image Theory).

Magnetostatics:

Magnetostatic Fields: Biot-Savart's Law, Ampere's Circuit Law (Maxwell's Equation), Application of Ampere's Law, Magnetic Flux Density, Magnetic Flux, Magnetic Flux Lines (or Magnetic Lines of Force), Gauss's Law for Magnetostatic Fields (Maxwell's Equation), Maxwell's Equations for Static Electric and Magnetic Fields, Energy Stored and Energy Density in Magnetostatic Fields, Magnetic Scalar and Vector Potential; Magnetic Forces, Materials and Devices: Forces due to Magnetic Fields, Magnetic Dipole Moment (or Magnetic Moment), Magnetic Torque, Magnetic Dipole, Magnetization in Materials, Classification of Materials, Magnetization Curve (or B-H Curve), Magnetic Boundary Conditions, Inductors and Inductances.

Maxwell's Equations:

Faraday's Law of Induction (Maxwell's Equation), Transformer and Motional Electromotive Forces, Displacement Current, Maxwell's Equations.

Electromagnetic Wave Propagation:

Time-Harmonic Fields, Phasors, Waves, Plane Waves, Wave Equations, Wave Propagation: Wave Propagation in Lossy Dielectrics, Wave Propagation in Lossless Dielectrics, Wave Propagation in Free Space, Wave Propagation in Good Conductors, Poynting's Theorem and Poynting Vector, Power, Wave Polarization, Reflection of a Plane Wave: Reflection of a Plane Wave at Normal Incidence, Reflection of a Plane Wave at Oblique Incidence.

Transmission Lines:

Transmission Line Parameters, Transmission Line Equations, Input Impedance, Standing Wave Ratio, Power, Smith Chart, Some Applications of Transmission Lines, Transients on Transmission Lines.

Reference Books:

1. Elements of Electromagnetics, Matthew N.O. Sadiku, Fourth Edition, Oxford University Press, 2007
2. Engineering Electromagnetics, William H. Hayt, John A. Buck, Nineth Edition, McGraw-Hill, 2018
3. Microwave Engineering, Annapurna Das and Sisir K. Das, Third Edition, McGraw-Hill, 2015

Course Title : STATISTICAL SIGNAL PROCESSING
Course Code : ECC404
Weekly contact : 3 – 1 – 0 (L – T – P)
Credit : 4

Revision: Probability, Statistics, Linear algebra and Vector space:

Probability, Random variable, Random Process; Linear and Matrix algebra; Time-series models

Decision Theory:
Difference between decision theory and estimation theory; Introduction to Decision Theory: Basic components; Binary Hypothesis Testing Bayes Criterion; Neyman-Pearson (NP) criterion; Mimi-max decision rule; Locally most powerful (LMP) detector; Energy detector; Sign detector; Week-signal detection; Non-parametric detection (optional)

Estimation Theory:
Introduction to Estimation Theory: Basic components; Properties of a good estimator; Estimator accuracy; Estimation approaches and Choosing an Estimator; Minimum Variance Unbiased Estimation; Cramer-Rao Lower Bound; *Classical estimation techniques:* MLE, LS; *Bayesian estimation techniques:* MAP, MMSE; Linear Bayesian Estimator: LMMSE; Signal processing example:Wiener filtering; Kalman filtering.

Reference Books:
1. Fundamentals of Statistical Signal Processing (Vol-I): Estimation Theory, by Steven M. Kay, Prentice Hall.
2. Fundamentals of Statistical Signal Processing(Vol-II): Decision Theory, by Steven M. Kay, Prentice Hall.

Course Title : IPR LAW: CONCEPTS AND APPLICATIONS
Course Code : HUC401
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

Module I Introduction to Intellectual Property Rights
Concept of Property: Tangible and Intangible Property; Intellectual Property: Origin, Development and Relevance: National and International perspectives, Classification of Intellectual Property: Industrial and Copyright, Justification of Intellectual Property, Development of *sui generis* systems in IP, National IPR Policy, IP Management.

Module II Patent Law
Nature, Definition and Scope of Patent Law; Types of Patent – Product and process patents, Patentable and Non-Patentable Inventions, Criteria for Patent: Novelty, Inventive Step, Industrial Applicability, Written Description and Best Mode; Patent Claims and Specification; Overview of Patent Procedure, Infringement of Patents; Remedies, Compulsory Licenses.

Module III Copyright and Related Rights

Nature, Scope and Development of Copyright; Conditions for Grant of Copyright: Originality, Expression, Fixation, Copyright Protection to Computer Database and Software and Digital Copyright; Assignment, Licensing: Types and Revocation, Extent of Rights and Exceptions to Copyright Protection; Moral Rights; Neighboring Rights; Infringement, Penalties and Remedies.

Module IV: Trade Marks & Industrial Design

Nature, Concept and Scope of Trade Marks; Subject Matter of Trade Marks, Types of Trade Marks, Overview of Trade Mark Registration and Rights Conferred, Exploitation of Trademarks: Assignment, Transmission and Licensing, Infringement and Passing-off; Penalties and Remedies; Withdrawal of Registration; Industrial Design and its different aspects, Designs Act, 2000: Overview of the Act; Objective; Conditions for Grant of Protection; Rights Conferred, Exceptions.

Text Reading:

1.B. L. Wadehra, Law Relating to Intellectual Property, Universal Law Publishing, 2016 (5th Edition).
2.Elizabeth Verkey, Intellectual Property, Eastern Book Company, 2015 (1st Edition)
3.P. Narayanan, Intellectual Property Law, Eastern Law House, 2018 (3rd Edition)
Sreenivasulu N.S., Intellectual Property Law- Dynamic Interfaces, Lexis Nexis, 2017 (1st Edition).
4.V. K. Ahuja, Law Relating to Intellectual Property Rights, Lexis Nexis, 2017 (3rd Edition)

References:

1. Cornish, Lewelyn & Aplin, Intellectual Property: Patents, Copyrights, Trademarks & Allied Rights, Sweet & Maxwell, 2019 (9th Edition).
2. Bently & Sherman, Intellectual Property Law, OUP Oxford, 2018 (5th Edition)
3. Sreenivasulu N.S., Law Relating to Intellectual Property, Lexis Nexis, 2018 (2nd Edition)
4. Susan K Sell, Private Power, Public Law: The Globalization of Intellectual Property Rights, Cambridge University Press, 2003
5. N.S. Gopalakrishnan & T.G. Ajitha, Principles of Intellectual Property, Eastern Book Company,2nd Edition , 2014
6. Jayashree Watal, Intellectual Property Rights in the WTO and Developing Countries, Oxford University Press, 2001
7. Duggal Pavan, Legal Framework on Electronic Commerce & Intellectual Property Rights, Universal Publishing House, 2014

8. Paul Torremans, Intellectual Property And Human Rights, Kluwer Law International, 2008
9. Steven D Anderman, Interface Between Intellectual Property Rights and Competition Policy, Cambridge University Press, 2007.
10. Philippe Cullet, Intellectual Property Protection and Sustainable Development, Lexis Nexis, 2005.

7. Additional Reading:

1. Journal of Intellectual Property Rights (NISCAIR)
2. Oxford Journal of Intellectual Property Law & Practice
3. The WIPO Journal.

8. SEMESTER – V

Course Title : COMMUNICATION– I
Course Code : ECC501
Weekly contact : 3 – 1 – 0 (L – T – P)
Credit : 4

Amplitude Modulation:

a) AM and DSB-SC:

Introduction, AM: Time-Domain description, Frequency – Domain description. Generation of AM wave: square law modulator, switching modulator. Detection of AM waves: square law detector, envelop detector. Double side band suppressed carrier modulation (DSBSC): Time-Domain description, Frequency-Domain representation, Generation of DSBSC waves: balanced modulator, ring modulator. Coherent detection of DSBSC modulated waves. Costas loop.

b) SSB, QAM and VSB:

Quadrature carrier multiplexing, Hilbert transform, properties of Hilbert transform, Pre- envelope, Canonical representation of band pass signals, Single side-band modulation, Time and Frequency Domain description of SSB wave. Phase discrimination method for generating SSB modulated wave. Demodulation of SSB waves. Generation of VSB modulated wave, Envelop detection of VSB wave with carrier, Comparison of amplitude modulation techniques, Frequency translation, Frequency division multiplexing, Application: Radio broadcasting, AM radio.

Angle Modulation:

a) Basic definitions, FM, narrow band FM, wide band FM, transmission bandwidth of FM waves, Carson's Rule, generation of FM waves: indirect FM and direct FM.

b) Demodulation of FM waves, FM stereo multiplexing, Phase-locked loop, Nonlinear model of the phase – locked loop, Linear model of the phase – locked loop, Nonlinear effects in FM systems.

Review of Random Variables and Stochastic Processes:

a) Review of commonly encountered variables in communication theory, including statistical averages, moment generating functions, functions of random variables, and evaluating moments. Examination of correlation and covariance, including autocorrelation and cross-correlation functions. Discussion of the Central Limit Theorem.

b) Introduction to random processes with examples, discussion of statistical averages, moments, autocorrelation and cross-correlation functions, properties of Gaussian processes, stationarity, ergodicity, and power spectral density.

Noise in continuous-wave modulation systems

a) Introduction, shot noise, thermal noise, white noise, Noise equivalent bandwidth, Narrow bandwidth, Noise Figure, Equivalent noise temperature, cascade connection of two-port networks
b) Receiver model, Noise in DSB-SC receivers, Noise in SSB receivers, Noise in AM receivers, Threshold effect, Noise in FM receivers, FM threshold effect, Pre-emphasis and De-emphasis in FM

Reference Books:

1. B. P. Lathi, Z. Ding "Modern Digital and Analog Communication Systems", Oxford University Press, 2010.
2. S. Haykin, "Communication Systems", Wiley India Edition, 2009.

Course Title : CONTROL SYSTEM ENGINEERING
Course Code : EEC501
Weekly contact : 3 – 1 – 0 (L – T – P)
Credit : 4

Introduction:
What is control, meaning of the terms reference input, control input, disturbance input and controlled output, tracking and the disturbance rejection problems, manual vs. automatic control, feedback and feed forward control

Modelling:
Impulse response and convolution integral for LTI systems, I/O relation in Laplace domain and Transfer function, block-diagram (and signal-flow-graph) representation of systems and their reduction to get T/F, normalized T/F, concept of states, state-space modelling of general systems, operating points and linearization about the same, state-space to transfer function transformation and the reverse (i.e., realization) problem for LTI systems, incremental transfer function

Characterization of plants:
Asymptotic and BIBO stability, significance of poles and eigenvalues, internal stability, Routh-Hurwitz test, time-domain impulse- and step responses of 1- and 2-pole systems, settling time, over-shoot etc. in terms of damping coefficient and natural frequency, effect of zero near the origin (and in rhp), definition and significance of frequency response, relation between time- and frequency-response features (of 2-pole plants), Nyquist and Bode plots

Analysis of effects of feedback:
Stability analysis of C/L systems from O/L Nyquist and Bode plots, O/L plant - types and C/L steady-state errors for step and ramp inputs, C/L root-loci for variation of loop gain (or other parameter), sensitivity transfer

functions (S and T) and their significance, measure of loop robustness in terms of the peaks of S and T

Compensation techniques:
Performance goals - steady state, transient and robustness specifications, time-domain vs. frequency-domain design approaches, PID, lag-lead, and pole placement design techniques, 2 degree-of-freedom control

Reference Books:

1. Automatic Control System, Tenth Edition, by Farid Golnaraghi and Benjamin Kuo
2. Control System Engineering, Sixth Edition, by IJ Nagrath and M Gopal
3. Ogata, K., Modern Control Engineering, Pearson Education.
4. Nise, N. S., Control Systems Engineering", Wiley
5. Matlab for Control Engineers: [https://www.mathworks.com/academia/books/matlab-for-control-engineers-ogata.html]
6. Matlab Control System Toolbox [https://in.mathworks.com/products/control.html]

Course Title	**: MICROPROCESSOR and MICROCONTROLLER SYSTEM**
Course Code	**: ECC502**
Weekly contact	**: 3 – 0– 0 (L – T – P)**
Credit	**: 3**

Introduction to Microcomputer based system.

8085 Microprocessor
Architecture of 8085 Microprocessor. Address / Data Bus multiplexing and demultiplexing. Status and Control signal generation, Instruction set of 8085 Microprocessor. Classification of instructions, addressing modes, timing diagram of the instructions, Assembly language programming: Addition, Multiplication, Block Transfer, Ascending order, Descending order, Finding largest & smallest number, Look-up table etc. , Memory interfacing with 8085, ADC / DAC interfacing with 8085, Interrupts of 8085 processor: classification of interrupts, Basic concept of serial I/O, DMA, Asynchronous and synchronous serial transmission using SID and SOD pins of 8085 Microprocessor, Support IC chips: PPI 8255

8051 Microcontroller

8051 architecture :8051 micro controller hardware, input/output pins, ports, external memory, counters and timers, Instruction set, addressing modes, Serial data i/o, Interrupts of 8051 processor: classification of interrupts, Assembly language Programming using 8051 :External data moves, Logical operations: Byte-level, bit-level, rotate and swap operations. ,Arithmetic operations ,Flags, incrementing and decrementing, addition, subtraction, multiplication and division, decimal arithmetic. Jump and call instructions, Interfacing of 8051 with different sensors

Arduino Uno

Introduction to Arduino, Architecture of Arduino, Pin description , Programming with Arduino, Interfacing of Arduino with different sensors

Raspberry pi

Introduction to Raspberry pi, Architecture of Raspberry pi, Pin description, Programming with Raspberry pi, Interfacing of Raspberry pi with different sensors

Reference Books:

1. Microprocessor architecture, programming and applications with the 8085 - Ramesh Gaonkar
2. Microcontroller :Theory and Applications - Ajay V Deshmukh
3. Programming Arduino :Getting started with sketch - Simon Monk
4. Raspberry Pi Cookbook-Simon Monk

Course Title : Humanities-IV(Organizational Behaviour)
Course Code : HUC501
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

Introduction:

Historical development; concept of organization; elements of organizational structure; scope of organizational behaviour.

Motivation and Job Satisfaction:

Major theories; content and process; Maslow, Herzberg, Douglas McGregor's theory X and theory Y, Intrinsic and extrinsic motivation; incentive systems: Job satisfaction; concept and determinants.

Leadership:

Functions and approaches; trait, behavioural and contingency models; characteristics of successful leaders; role of power in leadership.

Communication:
Communication process: types of communication; communication channels and networks; barriers to communication.

Group Behaviour and Conflict:
Defining and classifying groups; stages of group development; concept, causes and consequences of conflicts; methods of conflict-resolution.

References:

1. Luthans, F. (2005). Organizational Behavior (12th Ed.). New York: McGraw Hill.
2. Robbins , S., Judge, T.A., & Sanghi, S.. (2009). Organizational Behavior 13th Ed., Pearson Education.
3. Aamodt, M. G. (2001). Industrial/organizational psychology. New Delhi: Cengage

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Course Title : Soft Skill Development
Course Code : HUC 511
Weekly contact : 0 – 0 – 3 (L – T – P)
Credit : 2

Introduction to Soft Skill
Definition and Significance of Soft Skills; Importance, Process, and Measurement of Soft Skill Development.

Discovering/Relocating the Self
Strengths and Limitations; Habits; Goals Setting, Proactive Attitude Development, Faiths Beliefs, Values, Virtue.
Developing Positive Thinking and Driving out Negativity
Developing Self-Esteem and Building Self Confidence, Significance of Self-Discipline.

Motivation
Meaning and Theories of Motivation; Enhancing Motivation Levels.

Interpersonal relations
Communicating Clearly: Understanding and Overcoming barriers communication models, team communication; developing interpersonal relationships through effective communication

Active Listening
Listening is a skill.
Essential formal writing skills; corporate communication styles – Conducting Meetings, Writing Minutes, Sending Memos and Notices; Netiquette: Effective E-mail Communication; Telephone Etiquette; assertion, persuasion, negotiation.

Public Speaking
Skills, Methods, Strategies for effective public speaking.
Practice Tips
Practical in Language Lab
Group Discussion: Importance, Strategies for group discussion: Planning, Elements, Skills assessed; Effectively disagreeing, Initiating, Summarizing and Attaining the Objective.
Practical in Language Lab

Body Language
Introduction, Effective body language building during communication
Practical in Language Lab

Teamwork and Leadership Skills
Concept of Teams; Building effective teams; Concept of Leadership and honing Leadership skills.
Presentation Skills: Introduction, Types, Content, Audience Analysis,
Strategy: Before, During and After
Effect of Adrenalin
Practical at Language Lab

Interview Skills
Introduction, Strategies behind successful Interview
Interviewer and Interviewee – in-depth perspectives. Before, During and After the Interview, Introduction to Emotional Intelligence Skill.
Practical in Language Lab

Time Management
Introduction, Importance and Strategy behind effective time management.
Adverse Effects

Etiquettes and Manners
Introduction to Life Skills

CV Preparation
Introduction Importance and discussions on model CVs according to need of the employers.

Decision Management
Introduction and importance
Software behind Decision Management.

Conflict Management
Introduction and importance

Stress Management

Introduction and importance

Course Title	**: Communication - I Laboratory**
Course Code	**: ECC 511**
Weekly contact	**: 0 – 0 – 3 (L – T – P)**
Credit	**: 2**

Experiment-1

- Analyze the working of frequency mixers and their use in communication systems.

Experiment-2

- Study and analyse Amplitude Modulation (AM) in time domain and frequency domain.
- De-modulate AM signal using a) diode detector, b) Product detector, c) Envelop detector.

Experiment-3

- Implement and observe DSB-SC modulation technique in time domain and frequency domain.
- Study the DSB-SC reception using Envelop and Diode detector.

Experiment-4

- Conduct SSB-SC modulation and observe in time domain and frequency domain.
- Study of the SSB-SC reception using Product detector.

Experiment-5

- Study the working principles of a superheterodyne receiver.

Experiment-6

- Implement and observe frequency modulation (FM) using Varactor Modulator and VCO Modulator, and observe in time domain and frequency domain.
- Observe and measure the frequency deviation and modulation index of FM.

Experiment-7

- Study of Pre-emphasis circuit in FM at Transmitter side.
- Study of De-emphasis circuit in FM at Receiver side.

Experiment-8

- Study of frequency modulation via Phase modulation and vice-versa.

Experiment-9

- Explore and verify the principles of signal sampling and reconstruction.

Experiment-10

- Implement and analyze Frequency Division Multiplexing (FDM) and Time Division Multiplexing (TDM) techniques.

Course Title	**: MICROPROCESSOR and MICROCONTROLLER SYSTEM LABORATORY**
Course Code	**: ECC 512**
Weekly contact	**: 0 – 0– 3 (L – T – P)**
Credit	**: 2**

List of Experiments:

1) Study of programs using the basic instruction set of 8085 microprocessor(data transfer, Load/Store, Arithmetic, Logical, data transfer) on the 8085 simulator on PC

Example

- 8 bit addition, subtraction, 16 bit addition, block addition
- Shifting a block of memory
- Multiplication, division
- Look up table
- Factorial
- Fibonacci series
- Sorting of numbers etc.

2) Study of programs using the basic instruction set of 8051 microcontroller (data transfer, Load/Store, Arithmetic, Logical, data transfer) on the 8051 simulator on PC
3) Interfacing of different sensors with 8051 microcontroller chip
4) Study of basic programs using the basic instruction set of Arduino Uno
5) Interfacing of different sensors with Arduino Uno
6) Familiarization of Raspberry pi module
7) Interfacing of sensors with Raspberry pi module.

9.

10. SEMESTER – VI

Course Title : COMMUNICATION– II
Course Code : ECC601
Weekly contact : 3 – 1 – 0 (L – T – P)
Credit : 4

Introduction to Digital Communication

Digital Data Transmission:
Concept of sampling, Pulse Amplitude Modulation (PAM), Multiplexing of samples: Frequency Division and Time Division Multiplexing Pulse Code Modulation (PCM), quantization, uniform and non-uniform quantization, quantization noise, binary encoding, A-Law and μ -law companding, differential PCM, delta modulation and adaptive delta modulation.
Digital transmission components, source, multiplexer, line coder, regenerative repeater, concept of line coding – polar/unipolar/bipolar NRZ and RZ, Manchester, differential encoding and their PSDs.
Error Control Coding:
Source Coding: Information, Entropy, Fixed length and Variable length coding, Huffman coding.
Pulse shaping, Inter Symbol Interference (ISI), Eye pattern, Nyquist criterion for zero ISI, equalizer, zero forcing equalizer, timing extraction.

Digital Modulation Techniques:
Types of Digital Modulation, coherent and non-coherent Binary Modulation Techniques, basic digital carrier modulation techniques: ASK, FSK and PSK, Coherent Binary Phase Shift Keying (BPSK), geometrical representation of BPSK signal; error probability of BPSK, generation and detection of BPSK Signal, power spectrum of BPSK. Concept of M-ary Communication, M-ary phase shift keying, the average probability of symbol error for coherent M-ary PSK, power spectra of MPSK, Quadrature Phase Shift Keying (QPSK), error probability of QPSK signal, generation and detection of QPSK signals, power spectra of QPSK signals, Coherent Frequency Shift Keying (FSK), Binary FSK, error probability of BFSK signals, generation and detection of Coherent Binary FSK signals, power spectra of BFSK signal,
Minimum Shift Keying (MSK), signal constellation of MSK waveforms, error probability of MSK signal.

Signal Vector Representation:
Analogy between signal and vector, distinguishability of signal, orthogonality and orthonormality, basis function, orthogonal signal space, message point , signal constellation, geometric interpretation of signals, likelihood functions, Schwartz inequality, Gram-Schmidt orthogonalization procedure, response of

the noisy signal at the receiver, maximum likelihood decision rule, decision boundary, optimum correlation receiver; probability of error, error function, complementary error function. Basic concept of OFDM, constellation diagram.

TEXT BOOKS:

i) Modern Digital and Analog Communication Systems, B.P.Lathi and Z.Ding, Oxford University Press.
ii) Principles of Communication Systems, H. Taub and D.L.Schilling, TMH Publishing Co.
iii) Digital Communications, J.G.Proakis, TMH Publishing Co.

REFERENCE BOOKS:

i) Digital Communications Fundamentals and Applications, B. Sklar and P.K.Ray, Pearson.
ii) Digital Communication, A. Bhattacharya, TMH Publishing Co.

Course Title : DIGITAL SIGNAL PROCESSING
Course Code : ECC 602
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

Introduction:
Reasons behind digital processing of signals, brief historical development, leading to organization of the course. Discrete-time sequences, Discrete Linear Time Invariant (LTI) systems, causality, stability, Inverse Systems, difference equations.

Discrete-time Fourier series (DTFS), Discrete-time Fourier Transforms (DTFT)

Discrete Fourier transform (DFT):
Properties of DFT, circular convolution, motivation towards FFT algorithms

Z –Transform:
Definition, region of convergence (ROC) in the Z plane, properties of Z transform, relationship between Fourier transform and Z transform, Inverse Z transform, minimum and maximum phase transfer functions, all-pass transfer functions, spectral factorization

Characterization of Discrete-time Systems:

Frequency response of discrete-time systems, concept of eigen functions, concept of FIR and IIR, understanding the basic digital filtering problem, understanding the frequency-domain behaviour of basic FIR and IIR systems, All-pass systems, comb filters, Linear Phase filters

FIR filter design techniques:
Windowing method for designing FIR filters, Frequency-sampling method for designing FIR filters

IIR filter design techniques:
Analog Filter Design, Analog Butterworth lowpass filter design techniques, Analog Chebyshev LPF, frequency transformation for converting normalized lowpass filters into other de-normalized types, Design methods to convert analog filters into digital filters (Bilinear Transformations, Impulse Invariant Transformations), All-pass filters for phase equalization.

Digital filter structures:
system describing equations, direct form I and II structures, cascade and parallel communication of second order systems, Polyphase representation of filters, linear phase FIR filter structures, Compensatory Transfer Functions, frequency sampling structure for the FIR filter

Reference Books:

3. Discrete-Time Signal Processing (Second Edition), Alan V. Oppenheim, Ronald W. Schafer, and John R. Buck, Pearson Education India
4. Digital Signal Processing: A Computer-Based Approach (Indian Edition), Sanjit K Mitra, McGraw Hill
5. Digital Signal Processing by Tarun Kumar Rawat, Oxford University Press

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Course Title : COMPUTER NETWORKS
Course Code : CSC601
Weekly contact : 3 – 1 – 0 (L – T – P)
Credit : 4

Introduction:
Introduction to Computer Network, Uses of Computer Networks, Modes of Communications, Different types of Networks, Network Structure, Communication Model, Internet, Protocol, OSI and TCP/IP models

Layers:
Design Issues for the layers, Discussion about Layers.

Application Layer:

DNS, Remote login (TelNet), Email (SMTP, MIME, POP3, IMAP4), WWW, HTTP, Cookie, Proxy Server, File Transfer Protocol, TFTP.

Transport Layer:
Multiplexing, Demultiplexing, UDP, TCP, RTT Estimation and Timeout, TCP Flow Control. TCP Error Control and Congestion Control

Network Layer:
Virtual Circuits and Datagram Networks, inside a Router, Forwarding and Addressing in the Internet. IPv4 Addressing

Routing:
Shortest Path, Flooding, Link State, Distance Vector, Hierarchical Routing, Routing in the Internet: RIP, OSPF, Border Gateway Protocol, and Multicasting.

Data Link Layer:
Services, Error Detection and Correction Techniques

Multiple Access Protocol:
TDM, FDM, Slotted ALOHA, Pure ALOHA, CSMA, CSMA/CD, LAN, Ethernet, Point to Point Protocol.

Link Layer Addressing:
MAC Addresses, ARP, DHCP.

Interconnections:
Hubs, Bridges, and Switches.

Physical Layer:
Theoretical basis for communication, guided transmission media, wireless transmission, the public switched telephone networks, mobile telephone system.

Reference books:
1. B. A. Forouzan, & F. Mosharraf. Computer Networks: A top down approach, 1st Edition, McGraw-Hill, 2012
2. B. A. Forouzan, TCP/IP Protocol Suite, 4th Edition, McGraw-Hill, 2010.
3. J. F. Kurose & K. W. Ross: Computer Networking: A Top-Down Approach Featuring the Internet, 3rd Ed., Pearson, 2006.
4. B. A. Forouzan, Data Communications and Networking, 4th Edition, McGraw-Hill, 2009.
5. W. Stallings, Data and Computer Communication, Prentice Hall.
6. A. S. Tanenbaum, Computer Networks, 5th Edition, Pearson, 2006

Course Title : MACHINE LEARNING

Course Code : CSC602
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

Introduction:
Concept Learning: Find-S, Candidate Elimination, Decision Tree

Learning Problems:
Well-Posed Learning Problems, Designing A Learning System, Perspectives And Issues In Machine Learning, A Concept Learning Task, Concept Learning As Search, Find-S, Version Spaces And The Candidate-Elimination Algorithm, Inductive Bias

Decision Tree:
Decision Tree representation, Appropriate problems for Decision Tree Learning, Basic Decision Tree Learning Algorithm, Hypothesis Space Search in Decision Tree Learning, Inductive bias in Decision Tree Learning, Issues in Decision Tree Learning

Artificial Neural Networks:
Gradient Descent, Artificial Neural Networks, Bayesian Learning, Expectation Maximization, Cost Function, Gradient Descent, Linear Regression, Neural Network Representations, Problems for Neural Network Learning, Perceptron, Multilayer Networks and Backpropagation Algorithm.

Bayes Theorem and Concept Learning:
Bayes theorem**,** Maximum Likelihood and Least-Squared Error Hypotheses, Maximum Likelihood Hypotheses for Predicting Probabilities, Bayes Optimal Classifier, Naive Bayes Classifier, Learning to Classify Text, Bayesian Belief Networks, EM Algorithm, EM Algorithm for Gaussian Distribution

Generative and Discriminative approaches:
Difference between Generative and Discriminative approaches, Naive Bayes, Hidden Markov model, Gaussian mixture model, Latent Dirichlet Allocation, Conditional Random Fields, Maximum-Entropy Markov models

Instance Based Learning:
k-Nearest Neighbor, Support Vector machine, Reinforcement Learning, Evaluation Methods, Application in NLP.

Reference books:

1. Tom M. Mitchell, Machine Learning, 2013 Indian Edition, McGraw-Hill Education, Inc.
2. Machine Learning Course in coursera by Andrew Ng, Link: https://www.coursera.org/learn/machine-learning#syllabus

3. Introduction to Machine Learning, Third Edition, Ethem Alpaydin, The MIT Press
4. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, The MIT Press
5. Online ppts: https://web.cs.hacettepe.edu.tr/~ilyas/Courses/BIL712/

Course Title : COMMUNICATION– II LABORATORY
Course Code : ECC 611
Weekly contact : 0 – 0 – 3 (L – T – P)
Credit : 2

List of Experiments:

1) Implementing Amplitude Shift Keying (ASK) modulation and demodulation in software/hardware.
2) Implementing Frequency Shift Keying (FSK) modulation and demodulation in hardware/software.
3) Implementing Binary Phase Shift Keying (BPSK) modulation and demodulation in software/hardware.
4) Implementing Quadrature Phase Shift Keying (QPSK) modulation and demodulation in software/hardware.
5) Implementing Pulse Amplitude modulation and demodulation in software/hardware.
6)Implementing Pulse Code modulation and demodulation in software/hardware.
7) Implementing Time Division Multiplexing (modulation and demodulation) in software/hardware.
8) Implementing the various line coding formats (polar RZ, polar NRZ, unipolar RZ unipolar NRZ, bipolar RZ, bipolar NRZ, Manchester format) in software/hardware.
9) Implementing Error Correcting Codes (Encoding and Decoding): Even parity, Odd parity, Hamming Codes in software/hardware.
10) Implementing Delta Modulation in software/hardware.
11) Implementing Adaptive Delta Modulation in software/hardware.

Course Title : DIGITAL SIGNAL PROCESSING LABORATORY
Course Code : ECC 612
Weekly contact : 0 – 0 – 3 (L – T – P)
Credit : 2

EXPERIMENT 1:
a) Generation of two discrete-time sequences of unequal length and plotting them with input for n=0th sample taken from the user.

b) Perform addition and multiplication between the generated sequences (with appropriate zero-padding whenever required).
c) Evaluating and plotting of even and odd parts of a given signal.
d) Generation and plotting of standard discrete-time sequences like discrete-time delta, unit step, ramp, exponential sequence, etc.

EXPERIMENT 2:
a) For a given discrete-time sequence, perform N sample delay/advancement.
b) Given two discrete-time sequences x[n] and h[n], where h[n] represents the impulse response of an LTI system, perform the convolution $y[n]=x[n]*h[n]$. This operation illustrates how the input sequence x[n] is transformed by the system's impulse response h[n]. Print the sequences x[n], h[n], and the resulting output y[n] to observe the effects of the convolution process.
c) Write a program to compute correlation between two sequences.

EXPERIMENT 3:
a) Generate a discrete-time periodic signal x[n]. Write a MATLAB program to compute the DTFS coefficients of x[n]. Plot the magnitude and phase of the DTFS coefficients.
b) Generate a discrete-time aperiodic signal x[n] of given length. Write a MATLAB program to compute the DTFT. Plot its magnitude and phase.

EXPERIMENT 4:
a) Computing the "N-point" DFT X(k) of a finite-length signal x[n] using matrix method. Plot x[n], along with the Magnitude and Phase plots of X(k).
b) Perform the reverse operation from X(k) to x[n] by matrix inversion (or conjugation). Verify whether the inverse operation leads to x[n] or not.
c) Generate two discrete-time sequences x1[n] and x2[n] by taking sample inputs from the user. Compute the circular convolution between the two sequences x1[n] and x2[n] using Circulant Matrix method and store the result in y1[n]. Plot y1[n].
d) For sequences x1[n] and x2[n] above, compute the Circular Convolution y2[n] by multiplying their respective DFTs and taking the IDFT (matrix method to perform DFT/IDFT operations could be used for example). Verify whether y2[n] is same as y1[n].
e) Find the linear convolution of two signals using circular convolution.

EXPERIMENT 5:
Design a FIR digital filter from a given set of specifications using windowing method. Ensure that the filter has linear phase using a suitable type (type – 1/2/3/4) impulse response. Order of the filter may be determined

empirically using standard available formulae (Hermann, Bellander, Kaiser, etc..). Iterate to meet the desired frequency response.

EXPERIMENT 6:

Design an IIR digital filter that satisfy a given set of magnitude specifications. To explore both Butterworth and Chebyshev types while designing the analog filter. To explore both Bilinear Transform and Impulse Invariant Transform for analog to digital conversion.

Reference Books:

1. Digital Signal Processing Using MATLAB, Vinay K Ingle, John G. Proakis
2. Discrete-Time Signal Processing (Second Edition), Alan V. Oppenheim, Ronald W. Schafer
3. Digital Signal Processing with MATLAB, Sanjit K Mitra, McGraw Hill

Course Title	**: COMPUTER NETWORKS LAB**
Course Code	**: CSC611**
Weekly contact	**: 0 – 0 – 3 (L – T – P)**
Credit	**: 2**

Familiarization with Networking Commands

Introduction to basic networking commands.

Study of network components and topologies

Study of different types of network cables, networking devices and network topologies.

TCP Socket Programming

1. Establish communication between client and server.
2. Send data from client, perform different operations in server and send the result to client in each of the following cases.
    a. Count number of 1s in a binary string.
    b. Cyclic redundancy check.
    c. Compute the value of a postfix expression.
    d. Check for palindrome.
    e. Reverse a string.
    f. Implement web-crawler.
    g. Multithreading.

UDP Socket Programing

1. Establish communication between client and server

2. Send data from client, perform different operations in server and send the result to client in each of the following cases.
    a. Count number of 1s in a binary string.
    b. Cyclic redundancy check.
    c. Compute the value of a postfix expression.
    d. Check for palindrome.
    e. Reverse a string.
    f. Implement web-crawler.
    g. Multithreading.

Implementation of Address resolution protocol (ARP) and Reverse Address resolution protocol (RARP)
Implement ARP and RARP using TCP and UDP.

HTTP
Implementation of HTTP server and testing through web browser.

11. SEMESTER – VII

Course Title : VLSI ENGINEERING
Course Code : ECC701
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

Introduction:
Design hierarchy, layers of abstraction, integration density and Moore's law, VLSI design styles, packaging styles, design automation principles

Fabrication technology:
Idea of Clean room, Si Substrate, Basic steps of fabrication, bipolar, CMOS fabrication processes, layout design rules

MOS characteristics and circuits:
MOS transistor characteristics, MOS switch and inverter, latch-up in CMOS inverter, super-buffers, propagation delay models, switching delay in logic circuits, CMOS analog amplifier

Logic design:
Switch logic, gate restoring logic, various logic families and logic gates, PLA

Dynamic circuits:
Basic concept, noise considerations, charge sharing, cascading dynamic gates, domino logic, np-CMOS logic, clocking schemes

Sequential circuits:

Basic regenerative circuits, bistable circuit elements, CMOS SR latch, clocked latch and flip-flops

Low-power circuits:
Low-power design through voltage scaling, estimation and optimization of switching activity, reduction of switched capacitance, adiabatic logic circuits

Subsystem design:
Design of arithmetic building blocks like adders, multipliers, shifters, area-speed-power trade-off

Semiconductor memories:
SRAM, DRAM, non-volatile memories

Testability of VLSI:
Fault models, scan-based techniques, BIST, test vector generation

Physical design:
Brief ideas on partitioning, placement, routing and compaction

Reference Books:
1. Weste, N.H.E, and Harris, D., CMOS VLSI Design: A Circuits and Systems Perspective, Pearson Education
2. Weste, Eshraghian, Principles of CMOS VLSI Design, Addison Wesley
3. Sung-Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis & Design, McGraw-Hill Higher Education

Course Code : ECC 702
Course Title : RF and Microwave Engineering
Weekly Contact : 3 – 1 – 0 (L – T – P)
Credit : 4

Introduction:
Microwave Engineering, Maxwell's Equations, Boundary Conditions.

Transmission Line Theory:
Transmission Line Parameters, Transmission Line Equations, Input Impedance, Standing Wave Ratio, Power, Smith Chart.

Matching Networks:
Quarter-Wave Transformer, Matching with Lumped Elements, Single-Stub Matching, Double-Stub Matching.

Network Analysis:
Scattering Matrix (S-Matrix), Reciprocal, Lossless and Matched Networks, Transmission Matrix (ABCD-Matrix).

Transmission Lines and Waveguides:
General Solutions for TEM, TE and TM Waves, Rectangular Waveguide, Coaxial Line, Microstrip Line.

Microwave Resonators:
Series and Parallel Resonant Circuits, Loaded and Unloaded Quality Factor, Transmission Line Resonators, Rectangular Waveguide Cavity Resonators.

Power Dividers and Directional Couplers:
Basic Theory of Power Dividers and Couplers, Three-Port and Four-Port Devices, Three-Port Power Dividers, T-Junctions, Wilkinson Power Divider, Four-Port Devices, Quadrature Hybrid Coupler, Rat-Race Coupler.

Microwave Tubes:
Basic Theory of Vacuum Tubes, Two Cavity Klystron, Reflex Klystron, Magnetron.

Text and Reference Books:
1. Microwave Engineering, David M. Pozar, Fourth Edition, John Wiley & Sons, 2012
2. Microwave Devices and Circuits, Samuel Y. Liao, Third Edition, Prentice Hall, 1996
3. RF and Microwave Wireless Systems, Kai Chang, First Edition, John Wiley & Sons, 2000
4. Radio-Frequency and Microwave Communication Circuits - Analysis and Design, - Devendra K. Misra, Second Edition, John Wiley & Sons, 2004

Course Title : VLSI ENGINEERING LABORATORY
Course Code : ECC711
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

1. **Experiments with LTSpice Circuit Design and Simulation Tool:** Designing basic Transistor Circuits using **LTSpice♥** (Analog Devices) tool and Simulate the functionalities with it.

2. **Exposure to Cadence Circuit Design Tool Suite (Virtuoso♥):**

- Getting to know how to setup a Linux environment for circuit design using Different MOS technologies available (180nm and 90nm).
- Recreate the circuits (done in LTSpice) using Virtuoso Schematic Editor and Spectre Circuit Simulator to study their functionalities.

3. **Design of Digital Logic Circuits (Cell Design) using Cadence Circuit Design Tool Suite (Virtuoso♥):**
   - Design the given logic circuits in 90/180nm and simulate them with **Spectre♥** Circuit Simulator to study their functionalities.
   - Getting to know how to make layout for the designed circuits using Cadence **Virtuoso Layout Suite**.

4. **Exposure to Siemens (Mentor Graphics) Calibre Tools for Physical Verification:**
   - Getting to know how to setup the environment for Physical Verification using **Calibre♥** DRC/LVS tools (180nm and 90nm).
   - Learn how to Extract Parasitic elements using Cadence **Quantus♥ Extraction Tool** in the Circuit Layout and incorporate them in post-layout simulation for design closure.

References:

1. LTSpice Online Materials from Analog Devices
2. Cadence Documentation and Online Materials for Circuit Design
3. Calibre Documentation from Siemens EDA (Mentor Graphics Corp).

Course Code : ECC 712
Course Title : RF and Microwave Engineering Laboratory
Weekly Contact : 0 – 0 – 3 (L – T – P)
Credit : 2

List of Experiments:

1. Study of Transmission Line Input Impedance, Reflection Coefficient and VSWR
2. Study of Quarter-Wave Transformer
3. Study of Single-Stub Matching
4. Study of ABCD Parameters and S Parameters
5. Determination of Waveguide Parameters
6. Determination of Microstrip Line Parameters
7. Determination of Resonant Circuit parameters
8. Determination of Directional Coupler Parameters
9. Design of 1:2 Equal Power Divider
10. Design of Rectangular Waveguide and Plot of Electric and Magnetic Fields

Reference Books:

1. Microwave Engineering, David M. Pozar, Fourth Edition, John Wiley & Sons, 2012
2. Microwave Devices and Circuits, Samuel Y. Liao, Third Edition, Prentice Hall, 1996
3. RF and Microwave Wireless Systems, Kai Chang, First Edition, John Wiley & Sons, 2000

ELECTIVES :

Course Title : PRINCIPLE OF NANO- ELECTRONICS AND DEVICES
Course Code : ECE 726
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

MOSFET device:

Journey from MOS capacitor to MOSFET device, Flat-band threshold voltages, Accumulation, Inversion, strong inversion regions, Capacitance-voltage characteristics at low and high frequencies, MOSFET device structure, Transfer and output characteristics, Small signal analysis, MOSFET as an amplifier and a switch, Transconductance, CMOS IC technology, CMOS latch-up phenomenon

MOSFET scaling:

Short Channel Effects: Limitation of long channel analysis, short-channel effects: velocity saturation, device degradation, channel length modulation, body bias effect, threshold adjustment, mobility degradation, hot carrier effects, MOSFET scaling goals, gate coupling, velocity overshoot, high field effects in scaled MOSFETs, substrate current and other effects in scaled MOSFETS. Moore's law, Technology nodes and ITRS, Physical & Technological Challenges to scaling, nonconventional MOSFET- (FDSOI, SOI, Multi-gate MOSFET)

Advanced Nano-electronics devices & materials:

Basics of FinFET and Gate-All-Around (GAA) transistor, 0D, 1D, 2D nanomaterials & bulk materials, their characterization techniques like FESEM, TEM, XRD, Raman & FTIR spectroscopy

Reference Books:

1. Physics of Semiconductor Devices by S. M. Sze and Kwok K. Ng, 3rd Edition, (John Wiley & Sons, 2002)

2. Semiconductor Physics and Devices by Donald A. Neamen, 3rd Edition, Mc Graw Hill, 2003
3. Microelectronic circuits by Adel S. Sedra & Kenneth C. Smith, Oxford university press, 2004
4. Fundamentals of Nanoelectronics by Hanson, Pearson

Course Title	**: REMOTE SENSING AND GIS**
Course Code	**: ECE722**
Weekly contact	**: 3 – 0 – 0 (L – T – P)**
Credit	**: 3**

Week 1: Introduction, electromagnetic radiation, basic laws
Week 2: Radiometry, Interaction of EMR with terrain features
Week 3: RS in visible and IR domain: Radiance to reflectance, atmospheric and topographic correction
Week 4: RS image acquisition, Different types of sensors, resolution concepts
Week 5: Resolution concepts, Spectral reflectance curves
Week 6: Spectral reflectance curves, Spectral indices
Week 7: Thermal infrared remote sensing
Week 8: Passive microwave radiometry
Week 9: Active microwave remote sensing: Imaging radar
Week 10: Platforms used for RS data acquisition and characteristics
Week 11: LIDAR, Common remote sensing datasets and data portals
Week 12: Applications of RS for land use and land cover monitoring, water resources management
Week 13: GIS and applications

NPTEL Courses:
https://nptel.ac.in/courses/105103193 (Prof. Rishikesh Bharti, Department of Civil Engineering, IIT Guwahati)
https://nptel.ac.in/courses/105101206 (Prof. Eswar Rajasekaran, Department of Civil Engineering, IIT Bombay)

Reference Books:
Joseph, G., Fundamentals of Remote Sensing.
Lillesand, T. M., Ralph, K. W. & Chipman, J., Remote Sensing and Image Interpretation
Sabins, F. F., Remote Sensing Principles and Interpretation.
Campbell, J. B., Introduction to Remote Sensing
Jensen, J. R., Remote Sensing of the Environment: An Earth Resource Perspective

Other References:
• https://onlinecourses.nptel.ac.in/noc21_ce61/preview
•https://www.nrsc.gov.in/Courses_Overview?language_content_entity=en

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• https://professional.ongeo.msu.edu/?gclid=Cj0KCQiAv8SsBhC7ARIsALIkVT0wx5ldGbhRqg3sWYc_GSghdDMlFI1R92-fOQE1XgmJbbG6X6pOS30aAuvyEALw_wcB
•https://www.colorado.edu/aerospace/academics/graduates/curriculum/remote-sensing-earth-space-sciences

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Course Title : ANTENNA ENGINEERING
Course Code : ECE 730
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

Antenna Concepts and Parameters: Source of Radiation, Radiation Pattern, Beam-width, Directivity, Gain, Radiation Efficiency, Polarization, Radiation Resistance, Effective Aperture, Friis Transmission Formula

Fields and Properties:
Hertzian Dipole, Half-wave Dipole, Monopole, Loop Antenna, Horn Antenna, Reflector Antenna, Yagi-Uda Antenna, BTS Antenna

Microstrip Antennas:
Basic characteristics, Feeding methods, Radiation Mechanism, Design of rectangular and circular patch antennas

Antenna Array:
Two-element Array, Broad-side and End-fire Array, N-element Array, Pattern Multiplication, Beam Steering

MIMO Antennas:
MIMO Communications, MIMO Antennas, Antennas in Portable Electronic Devices

Antenna Measurement:
Gain, Radiation Pattern, Basics of Anechoic Chamber

Reference Books:
1. Antennas – J.D. Kraus
2. Antenna Theory – C.A. Balanis

Course Title : WIRELESS COMMUNICATIONS
Course Code : ECE 731
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

Module 1: To introduce a basic timeline of the progression of wireless technologies starting from 2G, (2nd Generation), through 3G (3rd Generation), 4G (4th Generation) and the most recent 5G (5th Generations) wireless technologies. Recap of a few key concepts of Digital Communication Systems (random variables, signal space concepts, optimum receivers, probability of error (BER, SER)) to comprehend new concepts introduced in the context of wireless communications.

Module 2: Concept of "Fading" channel, characterizing the BER for fading channels, understanding the "Principle of Diversity" which is of fundamental importance in understanding the performance and motivation of various recent technologies that enhance the reliability of modern wireless communication systems

Module 3: Modelling of wireless communication channels - multipath effects such as Delay-Spread, Coherence Bandwidth, the relation between ISI and coherence bandwidth, impact of Doppler on wireless systems, Jakes Model. Practical insights into the design of 3G/4G wireless communication systems and an intuitive understanding of the various physical properties and specifications of current systems like 5G and 6G.

Module 4: Multiple-Input Multiple-Output (MIMO) technology - introduction, diversity, spatial multiplexing, MIMO channel modelling, MIMO capacity, channel state information (CSI), capacity bounds, MIMO detection techniques, Maximum Likelihood Detection, Zero Forcing, Minimum Mean Square Error detection, beamforming, massive MIMO, recent research trends

Module 5: Orthogonal Frequency Division Multiplexing (OFDM) technology - introduction, multicarrier modulation, subcarrier spacing, orthogonality, cyclic prefix, IFFT/FFT operations, OFDM symbol structure, PAPR (Peak-to-Average Power Ratio), synchronization, channel estimation, equalization, OFDM system design, MIMO-OFDM, OFDMA (Orthogonal Frequency Division Multiple Access), inter-carrier interference, Doppler effects, frequency-selective fading, recent research trends

Module 6: To introduce the various aspects of wireless-system planning such as large-scale wireless-propagation models, wireless shadowing, link-budget analysis, and tele traffic modelling

Reference Books:

1. Principles of Modern Wireless Communication Systems – Theory and Practice, Aditya K. Jagannatham, McGraw Hill (India)
2. Wireless Communications, Andrea Goldsmith, Cambridge University Press
3. Wireless Communications: Principles and Practice, Theodore S.

Rappaport, Cambridge University Press
4. Fundamentals of Wireless Communication, David Tse, Pramod Viswanath, Cambridge University Press
5.Digital Communications, John G. Proakis, Masoud Salehi, McGraw Hill

12. SEMESTER – VIII

Course Title	**: 5G AND WIRELESS TECHNOLOGY**
Course Code	**: ECE 829**
Weekly contact	**: 3 – 0 – 0 (L – T – P)**
Credit	**: 3**

Module 1: Major 5G enabling technologies : Introduction to 5G Communication Signals & System

Overview of Mobile Fading Channels, Smart Antennas and Mobile Generation of cellular systems- Free Space propagation, Multipath propagation, large scale and small scale fading, flat fading, selective fading, Doppler and motion initiated fading , fast and slow fading , Case Study of a Specific Wireless Channel. Overview of MIMO and Smart antennas and Beamformation, Millimeter Wave Communication for 5G Applications, Mobile Generation of cellular systems from 1G to 6G

5G waveforms and Multiple Access - Orthogonal Frequency Division Multiplexing (OFDM), Filter Bank Multi Carrier (FBMC), OFDMA and NOMA,

5G use Cases Slices- 5G eMBB (enhanced Mobile Broadband), 5G eMTC (Enhanced Machine Type Communicatio) and 5G URLLC (5G Ultra-Reliable and Low Latency Communication) Use Cases

Module 2. 5G-ADVANCED technology 1 : OPEN-RAN (O-RAN) SPLIT ARCHITECTURE , Virtualization, 5G Core based SDN networking and CLOUD

5G OPEN RAN Introduction, Open RAN: Journey from Concept to Development, Evolution of the RAN,O-RAN Alliance Architecture, , Open RAN Security Aspects, Network virtualization in 5G, 5G core and SDN , MEC and CLOUD

Module 3: 5G-ADVANCED technology 2 : from O-RAN to B-RAN with AI automation and Blockchain security.

Resource sharing and Multiple vendors use case of O-RAN : O-RAN updated to Blockchain enabled RAN (B-RAN) , B-RAN as a Service (BaaS), Case study of B-RAN with AI automation and Blockchain security

Module 4: Implementation of 5G Communication System.

RAN TEST BEDs and DEMOs

Text Books:

1.Constandinos X. Mavromoustakis, George Mastorakis, Jordi Mongay Batalla, Internet of Things (IoT) in 5G Mobile Technologies, Volume 8, Springer International Publishing, Switzerland, 2016
2.Multiple Access Techniques for 5G Wireless Networks and Beyond, by Mojtaba Vaezi, Zhiguo Ding, and H. Vincent Poor, Springer 2018, in process.
3. Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency, by Emil Bj¨ornson, Jakob Hoydis, and Luca Sanguinetti, Foundations and Trends in Signal Processing, 2017.
4. Cloud Mobile Networks: From RAN to EPC, by Mojtaba Vaezi, Ying Zhang, Springer 2017.4. Millimeter Wave Wireless Communications by Theodore S. Rappaport, Robert W. Heath, Robert C. Daniels, James N. Murdock, Prentice Hall, 2014
5. Jyrki T. J. Penttinen, Michele Zarri, Dongwook Kim, Open RAN Explained, The New Era of Radio Networks, Wiley , 2024.

Reference Books:

1.Mehdi Bennis, M´erouane Debbah and H. Vincent Poor, Ultra-Reliable and Low-Latency Wireless Communication: Tail, Risk and Scale, arXiv:1801.01270 [cs.IT], January 8, 2018.
2.Petar Popovski, Ultra-reliable communication in 5G wireless systems arXiv:1410.4330v1 [cs.IT], 16 Oct, 2014.
3.He Chen, Rana Abbas, Peng Cheng, Mahyar Shirvanimoghaddam, Wibowo, Hardjawana, Wei Bao, Yonghui Li and Branka Vucetic, Ultra-Reliable Low Latency Cellular Networks: Use Cases, Challenges and Approaches, arXiv:1709.00560 [cs.IT].
4.'Blockchain- enabled_Network_Sharing_for_O-RAN':
(Downloadable from :
https://www.researchgate.net/publication/353048492_Blockchain-enabled_Network_Sharing_for_O-RAN)
5. D. Breitgand et al., "Dynamic Slice Scaling Mechanisms for 5G Multi-domain Environments," 2021 IEEE 7th International Conference on Network Softwarization (NetSoft), Tokyo, Japan, 2021, pp. 56-62, doi: 10.1109/NetSoft51509.2021.9492716.
(Downloadable from :
https://www.researchgate.net/publication/353490533_Dynamic_Slice_Scaling_Mechanisms_for_5G_Multi-domain_Environments)

6.F. Wilhelmi and L. Giupponi, "On the Performance of Blockchain-enabled RAN-as-a-service in Beyond 5G Networks," 2021 IEEE Global Communications Conference (GLOBECOM), Madrid, Spain, 2021, pp. 01-06, doi: 10.1109/GLOBECOM46510.2021.9685431.

Course Title : SATELLITE COMMUNICATIONS SYSTEMS
Course Code : ECE 824
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

Module 1:
Introduction: Introduction, Brief History of Satellite Communications, Overview of Satellite Communications.
Orbital Mechanics: Equations of the Orbit, Kepler's Three Laws of Planetary Motion, Orbit of a Satellite, Look Angle Determination, Orbital Effects in Communications Systems Performance
Satellite Link Design: Introduction, Basic Transmission Theory, System Noise Temperature and G/T Ratio.

Module 2:
Modulation and Multiplexing Techniques for Satellite Links: Frequency Modulation, Analog FM Transmission by Satellite, Digital Transmission, Digital Modulation and Demodulation, Digital Transmission of Analog Signals, Time Division Multiplexing.
Multiple Access: Introduction, Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Demand Access Multiple Access (DAMA), Random Access (RA), Packet Radio Systems and Protocols, Code Division Multiple Access (CDMA).

Module 3:
Error Control for Digital Satellite Links: Error Detection and Correction, Channel Capacity, Error Control Coding, Performance of Block Error Correction Codes, Convolutional Codes, Implementation of Error Detection on Satellite Links, Concatenated Coding and Interleaving, Turbo Codes.
Propagation Effects and their Impact on Satellite–Earth Links: Introduction, Attenuation, Depolarization, Propagation Effects, Rain and Ice Effects.

Text and Reference Books:
1. Satellite Communications, Timothy Pratt, Charles W. Bostian, Jeremy E. Allnutt, Second Edition, John Wiley & Sons, 2003
2. Satellite Communications Systems Engineering, Louis J. Ippolito Jr., First Edition, John Wiley & Sons, 2008
3. Satellite Communications, Dennis Roddy, Fourth Edition, McGraw-Hill, 2006
4. Satellite Communication Systems, Barry G. Evans, Third Edition, IET Telecommunications, 2008

Course Title : RF CMOS CIRCUITS
Course Code : ECE 834
Weekly contact : 3 – 0 – 0 (L – T – P)
Credit : 3

Module 1**:** Introduction to RF Circuits
Parallel RLC resonant networks, impedance matching, maximum power transfer theorem, RF front-end, image problem in receivers; direct-conversion receiver, noise, non-linearity, IIP3

Module 2: Noise in CMOS Circuits
Thermal Noise, Flicker Noise, Statistical Characteristics, Representation of Noise in Circuits, Noise in Current Mirror, Differential Amplifier, Noise-Power Trade-off, Noise Bandwidth

Module 3: Low Noise Amplifier
Important Parameters, Impedance Matching, Design Procedure, LNA Topologies, High-IP2 LNA, SGL0622Z LNA

Module 4: Mixer
Important Parameters, Design Procedure, Down-conversion, Up-conversion

Module 5: Power Amplifier
Important Parameters, Classification, Design Procedure, High-Efficiency PA, Push-Pull Amplifier, Load-Pull Analysis, QPA9901 RF Power Amplifier

Module 6: Voltage Controlled Oscillator
Important Parameters, Design Procedure, Phase Noise, Tuning Range Limitations, Low-Noise VCO, LO Interface.

Module 7: Phase-Locked Loop
Important Parameters, Design Procedure, Type-I and Type-II PLL, Phase Noise.

Reference Books:
1. "CMOS: Circuit Design, Layout, and Simulation" by R. Jacob Baker
2. "Design of Analog CMOS Integrated Circuits" by Behzad Razavi
3. "The Design of CMOS Radio-Frequency Integrated Circuits" by Thomas H. Lee
4. "RF Microelectronics" by Behzad Razavi