Course Curriculum and Syllabi of
Bachelor of Technology (B.Tech.)
Branch/Programme: Electronics and Communication Engineering
(2023 Regulations)

(Approved by the 7th and 8th Senate Meeting held on 23rd August 2023 & 12th April 2024 respectively)

भारतीय सूचना प्रौद्योगिकी संस्थान सेनापति, मणिपुर

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY SENAPATI, MANIPUR

(An Institute of National Importance by Act of Parliament, Government of India)

Mantripukhri, Imphal – 795002, Manipur, India.

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COURSE CURRICULUM

SEMESTER -I

Sem.	Course Code	Course Name	L	T	P	C
I	MA1011	Mathematics I	3	1	0	4
I	CS1011	Computer Programming	3	0	0	3
I	CS1111	Computer Programming Lab	0	0	2	1
I	EC1011	Digital Design	3	0	0	3
I	EC1111	Digital Design Lab	0	0	2	1
I	EC1012	Electrical Circuit Analysis	3	1	0	4
I	PH1011	Physics I	3	0	0	3
I	GE1091	English Language Skills I	3	0	0	3
	GE1092	Japanese Language Skills I				
	GE1091	Korean Language Skills I				
I	GE1091	Yoga for Holistic Health	0	0	2	1
I	GE1092	Induction Programme	0	0	2	1
			18	2	8	24
		Contact Hours / Week	28			

Humanities & Social Science (HS)	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total
3	7	12	0	0	0	0	2	24

SEMESTER -II

Sem.	Course code	Course Name	L	T	P	C
II	MA1012	Mathematics II	3	1	0	4
II	CS1012	Data Structures	3	0	0	3
II	CS1112	Data Structures Lab	0	0	2	1
II	EC1013	Basic Electronic Circuits	3	0	0	3
II	EC1112	Basic Electronic Circuits Lab	0	0	2	1
II	PH1012	Physics II	3	0	0	3
II	EN1012	English Language Skills II	3	0	0	3
	JA1012	Japanese Language Skills II				
	KO1012	Korean Language Skills II				
II	HS1091	HSS-I (Introduction to Entrepreneurship)	3	0	0	3
		Total	18	1	4	21
		Contact Hours / Week	23			

Humanities & Social Science	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total
6	7	8	0	0	0	0	0	21

SEMESTER -III

Sem.	Course Code	Course Name	L	T	P	C
III	MA2013	Probability and Random Processes	3	0	0	3
III	EC2031	Signals and Systems	3	0	0	3
III	EC2131	Signals and Systems Lab	0	0	2	1
III	EC2021	Semiconductor Devices	3	0	0	3
III	EC2022	Analog Circuits	3	0	0	3
III	EC2122	Analog Circuits Lab	0	0	2	1
III	CS2013	Object Oriented Programming	3	0	0	3
III	CS2113	Object Oriented Programming Lab	0	0	2	1
III	ECXXX	Microcontroller and Microprocessor	3	1	0	4
		Total	18	0	8	22
		Contact Hours / Week	26			

Humanities & Social Science (HS)	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total
0	3	12	7	0	0	0	0	22

SEMESTER -IV

Sem.	Course code	Course Name	L	T	P	C
IV	EC2014	Electromagnetic Theory	3	0	0	3
IV	EC2042	Principles of Communication	3	0	0	3
IV	EC2114	Principles of Communication Lab	0	0	2	1
IV	EC2032	Digital Signal Processing	3	0	0	3
IV	EC2132	Digital Signal Processing Lab	0	0	2	1
IV	ECXXX	Measurement and Instrumentation	3	0	0	3
IV	CS2041	Operating Systems	3	0	0	3
IV	CS2141	Operating Systems Lab	0	0	2	1
IV	EC3081	Control Systems	3	1	0	4
		Total	18	1	6	22
		Contact Hours / Week	25			

Humanities & Social Science (HS)	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total

0	0	4	18	0	0	0	0	22

SEMESTER -V

Sem.	Course Code	Course Name	L	T	P	C
V	EC3044	Digital Communication	3	0	0	3
V	EC3144	Digital Communication Lab	0	0	2	1
V	EC3051	Analog Integrated Circuits	3	0	0	3
V	EC3151	Analog Integrated Circuits Lab	0	0	2	1
V	EC3072	Embedded Systems	3	0	0	3
V	EC3172	Embedded Systems Lab	0	0	2	1
V	EC3046	Communication Network	3	1	0	4
V	PEXXX	Professional Elective – 1	3	0	0	3
V	OEXXX	Open Elective - 1	3	0	0	3
		Total	18	1	6	22
		Contact Hours / Week	25			

Humanities & Social Science (HS)	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total
0	0	0	16	3	3	0	0	22

SEMESTER -VI

Sem.	Course Code	Course Name	L	T	P	C
VI	EC3052	VLSI Design	3	0	0	3
VI	EC3152	VLSI Design Lab	0	0	2	1
VI	EC3061	Microwave Engineering	3	0	0	3
VI	EC3161	Microwave Engineering Lab	0	0	2	1
VI	EC4047	Mobile Communication	3	0	0	3
VI	PEXXX	Professional Elective – 2	3	0	0	3
VI	PEXXX	Professional Elective – 3	3	0	0	3
VI	OEXXX	Open Elective – 2	3	0	0	3
VI	ECXXX	Minor Project	0	0	4	2
		Total	18	0	8	22
		Contact Hours / Week	26			

Humanities & Social Science (HS)	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total
0	0	0	11	6	3	2	0	22

SEMESTER -VII

Sem.	Course Code	Course Name	L	T	P	C
VII	PEXXX	Professional Elective - 4	3	0	0	3
VII	PEXXX	Professional Elective - 5	3	0	0	3
VII	HSXXX	HSS Elective - 2	3	0	0	3
VII	OEXXX	Open Elective - 3	3	0	0	3
VII	ECXXX	Summer Internship	0	0	4	2
VII	ECXXX	Project – I	0	0	12	6
		Total	12		16	20
		Contact Hours / Week	28			

Humanities & Social Science (HS)	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total
3	0	0	0	6	3	8	0	20

SEMESTER -VIII

Sem.	Course Code	Course Name	L	T	P	C
VIII	ECXXX	Project/Internship – II	0	1	22	12
		Total	0	1	22	12
		Contact Hours / Week	24			

Humanities & Social Science (HS)	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total
0	0	0	0	0	0	12	0	12

SUMMARY OF COURSE CURRICULUM

Semester	Humanities & Social Science (HS)	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total Credit
I	3	7	12	0	0	0	0	2	24
II	6	7	8	0	0	0	0	0	21
III	0	3	12	7	0	0	0	0	22
IV	0	0	4	18	0	0	0	0	22

V	0	0	0	16	3	3	0	0	22
VI	0	0	0	11	6	3	2	0	22
VII	3	0	0	0	6	3	8	0	20
VIII	0	0	0	0	0	0	12	0	12
Total	12	17	36	52	15	9	22	2	165

Sl. No.	Course Work - Subject Area	Range of Total Credits (%)		Suggested Breakdown of Credits (for Total=176)	Minimum Credits
		Minimum	Maximum		
1	Humanities and Social Sciences (HS), including Management;	5	10	14	9-3
2	Basic Sciences (BS) including Mathematics, Physics, Chemistry, Biology;	15	20	30	2**6-9**
3	Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation;	15	20	30	2**7-9**
4	Professional Subjects-Core (PC), relevant to the chosen specialization/branch; (May be split into Hard (no choice) and Soft (with choice), if required;)	30	40	50	5**3-18**
5	Professional Subjects – Electives (PE), relevant to the chosen specialization/ branch;	10	15	20	1**8-6**
6	Open Subjects- Electives (OE), from other technical and/or emerging subject areas;	5	10	12	9-3
7	Project Work, Seminar and/or Internship in Industry or elsewhere.	10	15	20	1**8**
8	Mandatory Courses (MC);	Non-Credit		8 units	

ELECTIVES

Professional Elective (PE)	Semester	Course Title	Hours per week			Credits
			L	T	P	
Professional Elective - 1	5th	HDL based Digital System Design	3	0	0	3
			3	0	0	3
			3	0	0	3
Professional Elective - 2	6th	Information Theory and Coding	3	0	0	3
		Communication Systems	3	0	0	3

			3	0	0	3
Professional Elective - 3	6th	Antenna and Wave Propagation	3	0	0	3
		Microwave system Design	3	0	0	3
		Wireless Sensor Network	3	0	0	3
Professional Elective - 4	7th	Advances in Wireless Communication Technologies	3	0	0	3
		VLSI Technologies	3	0	0	3
		Modern Error correcting codes	3	0	0	3
Professional Elective - 5	7th	Statistical Signal Processing	3	0	0	3
		Biomedical Signal Processing	3	0	0	3
		Adaptive Signal Processing	3	0	0	3
Open Elective (OE)	**Semester**	**Course Title**	**Hours per week**			**Credits**
Open Elective - 1	5th	Computer Organization and Architecture	3	0	0	3
		Computer Graphics	3	0	0	3
			3	0	0	3
Open Elective - 2	6th	Internet of Things	3	0	0	3
		Artificial Intelligence	3	0	0	3
		Optimization Engineering	3	0	0	3
Open Elective - 3	7th	Image and Video Processing	3	0	0	3
		Audio and Speech Processing	3	0	0	3
		Natural Language Processing	3	0	0	3

HSS Elective (HS)

Sl. No.	Course Code	Course Title	Hours per week			Credits	Branch	Preferred semester
			L	T	P			
1	HS351	Introduction to Linguistics	2	0	2	6	All	V
	HS352	Environmental Sciences	3	0	0	6	All	V
	HS353	Professional Ethics for Engineers/ Ethics and Human Values	3	0	0	6	All	V
2	HS361	Principles of Management	3	0	0	6	All	VI
	HS362	Entrepreneurship and Management Functions	3	0	0	6	All	VI
	HS363	Organizational Behaviour	3	0	0	6	All	VI

DETAILED SYLLABI

SEMESTER-I

Sem.	Course Code	Course Name	L	T	P	C
I	MA1011	Mathematics I	3	1	0	4
I	CS1011	Computer Programming	3	0	0	3
I	CS1111	Computer Programming Lab	0	0	2	1
I	EC1011	Digital Design	3	0	0	3
I	EC1111	Digital Design Lab	0	0	2	1
I	EC1012	Electrical Circuit Analysis	3	1	0	4
I	PH1011	Physics I	3	0	0	3
I	GE1091	English Language Skills I	3	0	0	3
	GE1092	Japanese Language Skills I				
	GE1091	Korean Language Skills I				
I	GE1091	Yoga for Holistic Health	0	0	2	1
I	GE1092	Induction Programme	0	0	2	1
			18	2	8	24
		Contact Hours / Week	28			

Humanities & Social Science (HS)	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total
3	7	12	0	0	0	0	2	24

MA1011	MATHEMATICS I	3-1-0-4

Syllabus:

Linear Algebra: Systems of linear equations and their solutions; vector space Rn and its subspaces; spanning set and linear independence; matrices, inverse and determinant; range space and rank, null space and nullity, eigenvalues and eigenvectors; diagonalization of matrices; similarity; inner product, Gram-Schmidt process; vector spaces (over the field of real and complex numbers), linear transformations.

Single Variable Calculus: Convergence of sequences and series of real numbers; continuity of functions; differentiability, Rolle's theorem, mean value theorem, Taylor's theorem; power series; Riemann integration, fundamental theorem of calculus, improper integrals; application to length, area, volume and surface area of revolution.

Texts:

1. G. Strang, Linear Algebra and Its Applications, 4th Edition (South Asian Edition), Wellesley- Cambridge Press, 2009(ISBN: 9788175968110).
2. S. R. Ghorpade and B. V. Limaye, An Introduction to Calculus and Real Analysis, Springer India, 2006 (ISBN: 9788181284853).

References:

1. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
2. K. Hoffman and R. Kunze, Linear Algebra, 2nd Edition, Prentice Hall India, 2009.
3. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Edition, Wiley India, 2007.

CS1011	COMPUTER PROGRAMMING	3-0-0-3

Syllabus:

Need to study programming languages, Characteristics of Programming Languages, Programming language paradigms: Imperative, Object Oriented, Functional, Logic, Event Driven and Concurrent Programming, Language design issues, Language Translation issues, Data Types: properties of Types and objects, Elementary data types, structured data types, Type conversion, Binding and binding times.

Procedural programming through Language 'C': Basic Syntax and Semantics, Variables, Types, Expressions, Assignment statements, Scope of variables, Conditional and Iterative Control Structures, I/O, Functions and parameter passing, Strings and string processing, Pointers and References, Structures, Recursion.

Algorithm development: Techniques of problem solving, Stepwise Refinement, example of algorithm writing systems as a solution to mathematical problems (at least ten), algorithms for searching and sorting, merging order lists, Flow-chart for the above algorithms.

Texts:

1. Bryon Gottfried, Programming with C, McGraw Hill, Third edition (ISBN: 9780070145900).

References:

1. Horowitz, Sahni, and Anderson-Freed, Fundamentals of Data Structures in C, Universities Press, Second edition (ISBN: 9788173716058).
2. Kernighan and Ritchie, The C Programming Language, PHI, Second edition, (ISBN:9788120305960).
3. Roosta Seyed, Foundations of Programming Languages Design & Implementation, 3rd Edition, Cenage learning.

CS1111	COMPUTER PROGRAMMING LAB	0-0-2-1

Introduction to Linux OS, Free & Open source software, Basic tools & commands, Compiling and debugging C program with GCC & GDB.

Basic Assignment Statement, Conditional and Iterative Control Structures, Some Numerical Examples, Functions and parameter passing, Array and String, Pointer, Structure, Recursion, Dynamic Memory Allocation, File Handling, Command Line Arguments.

Implementation of the following problem statements using C programming language along with algorithm and flowchart are mandatory.

Solution to basic mathematical problems such as, largest of 2,3,..n numbers, factorial of a given number, Armstrong number, palindrome, LCM, GCD, sum digits, sum of series (arithmetic, geometric, alternating), printing octal, or hexadecimal equivalent of a given number or vice versa, solving quadratic equation, number pyramid, printing 1st 500 hundred prime numbers, swapping of numbers using pointers and without using third variable, Operations on matrix)

Arrange a list of numbers into a specific order (ascending, descending).

Arrange a list of strings into a specific order (ascending, descending, based on number of characters in the string etc., the order will be provided as command line argument.

Reverse a string using recursion and check whether the string is palindrome or not.

Count frequency of a specific character from a given paragraph

Generate character bigrams from a given paragraph

Remove all characters in a string other than alphabet

Count the frequency of digits after decimal and find maximum occurring digit in the PI value upto first 100 decimals (3.1415 92653 58979 32384 62643 38327 95028 84197 1 6939 93751 05820 97494 45923 07816 40628 62089 98628 03482 53421 17067)

Display the content of a file in reverse direction (similar to $cat and $tac commands)

Store student record such as height, weight, date of birth etc. of the batch using structure and display the stored details including average height and average weight.

Reference Book:

1. Bryon Gottfried, Programming with C, McGraw Hill
2. Horowitz, Sahni, and Anderson-Freed, Fundamentals of Data Structures in C, Universities Press, Second edition.
3. GDB https://www.eecs.umich.edu/courses/eecs373/readings/Debugger.pdf, https://ftp.gnu.org/old-gnu/Manuals/gdb/html_node/gdb_toc.html, https://www.sourceware.org/gdb/documentation/,
4. GCC https://www.cse.iitb.ac.in/grc/intdocs/gcc-basic-info.html, https://gcc.gnu.org/onlinedocs

EC1011	DIGITAL DESIGN	3-0-0-3

Syllabus:

Number System: Introduction to number systems, binary, Integer and floating-point- numbers, octal, hexadecimal and decimal number system and their conversion.

Arithmetic Operations: Binary addition & subtraction; 1's and 2's complement, subtraction using 2's complement; binary codes, addition and subtraction operations on binary-coded numbers; Algorithms for performing multiplication and division.

Combinational Circuits: Basic Logic Operations, AND, OR, NOR, NAND, EX-OR, EX-NOR Gates, Boolean expressions and their minimization using algebraic identities; Karnaugh map representation and minimization of Boolean functions using K-map; Don't care conditions, NAND and NOR logic implementations, two-level realizations using gates -- AND-OR, OR-AND, NAND-NAND and NOR-NOR structures.

Combinational Circuits using MSI Modules: Adders, subtractors, BCD arithmetic, serial adder, carry look-ahead adder, multi-bit adder, Multiplexers, De-multiplexers, Decoders, Multiplexer-based realization of K-maps; Combinational circuit design using multiplexers and gates. Programmable Logic Devices: ROM, PLA, PAL.

Sequential Circuits: Latches and Flip-flops; Ripple counters using T flip-flops; Synchronous counters; Shift Registers; Ring and MLS counters; Sequence generator using J-K / D flip-flops, Finite state machines, propagation delay, setup and hold time, critical path delay, Static RAM, Dynamic RAM.

Texts:

1. M. Morris Mano, Digital Logic and Computer Design, 11th Edition, Pearson Education, 2009.

References:

1. Ronald J Tocci, Neal S Wisdmer and Gregory L. Moss, Digital Systems: Principle and Applications, 10th Edition, Pearson Education, 2011.
2. Albert Paul Malvino, Donald P Leach and Gautam Saha, Digital Principles and Applications 7th Edition, Tata McGraw - Hill Education, 2011.

EC1111	DIGITAL DESIGN LAB	0-0-2-1

Familiarization with digital IC family 74LS00 and 74HS00. Familiarization with laboratory equipment – voltage generator, function generator, oscilloscope. Study of digital IC characteristics – input voltage, input current, output voltage, output current, fan out, noise margin and propagation delay. Combinational logic circuits: Implementation of Boolean functions using logic gates; Arithmetic operations using logic gates; Implementation of Multiplexers, De-multiplexers, Encoders, Decoders; Implementation of Boolean functions using Multiplexers/Decoders Study of sequential logic circuits: Implementation of flip flops, Implementation of counters, Implementation of sequence generators.

EC1012	ELECTRICAL CIRCUIT ANALYSIS	3-1-0-4

Syllabus:

Basic components and circuit analysis: Charge, current, voltage and power, voltage and current sources, Ohm's law; Voltage and current laws: nodes, paths, loops and branches, Kirchhoff's current law, Kirchhoff's voltage law, independent sources, voltage and current division; Basic nodal and mesh analysis: nodal analysis, super-node, mesh analysis, super-mesh; Network theorems: linearity and superposition, source transformations, Thevenin's theorem, Norton's theorem, reciprocity, maximum power transfer;

Magnetically coupled circuits: mutual inductance, energy considerations, linear transformer, ideal transformer;

Poly-phase circuits: Poly-phase systems, single-phase three-wire systems, three-phase Y-Y connection, wye-delta transformation, power measurement in three-phase systems;

Time and frequency domain analysis of linear circuits: Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Sinusoidal steady-state analysis: Forced response to sinusoidal functions, complex forcing function, phasor, phasor relationship for R, L and C, impedance, admittance, phasor diagrams, instantaneous power, average power, apparent power and power factor, complex power;

Two-port networks: one-port networks, linear 2-port network parameters, admittance parameters, impedance parameters, hybrid parameters, transmission parameters.

Texts:

1. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata-McGraw-Hill Publishing Company Limited, 7th / 8th Edition, 2010/ 2012.

References:

1. Bruce Carlson, Circuits: Engineering Concepts and Analysis of Linear Electric Circuits, 2nd Reprint, Thomson Asia Pvt. Ltd., 2006.
2. R. A. De Carlo and P. M. Lin, Linear Circuit Analysis, 2nd Edition, Oxford University Press, 2001.

PH1011	PHYSICS I	3-0-0-3

Syllabus:

Special Theory of Relativity: Michelson-Morley experiment, Postulates of STR. Galilean transformation. Lorentz transformation. Simultaneity. Length Contraction. Time dilation. Relativistic addition of velocities. Energy momentum relationships.

Quantum Mechanics: Two-slit experiment. De Broglie's hypothesis. Uncertainty Principle, wave function and wave packets, phase and group velocities. Schrödinger Equation. Probabilities and Normalization. Expectation values.

Eigenvalues and eigen functions. particle in a box, potential barrier, harmonic oscillator

Solid State Physics: Crystal lattices and symmetry groups, reciprocal lattice, Brillouin zone, Miller indices, crystal structure by X-ray diffraction; free electron theory, electrons in a periodic potential, Bloch's theorem, Kronig-Penny model, formation of bands, effective mass, holes, classification of metal, insulator and semiconductor, intrinsic and extrinsic semiconductors, law of mass action, Hall effect; Curie law, concepts of ferro, ferri, and anti-ferro magnetism

Texts:

1. Kenneth S. Krane, Modern Physics, John Wiley &Sons, Inc, 3rd Edition, 2012
2. C. Kittel, Introduction to Solid State Physics, John Wiley & Sons, 2005.

References:

1. Beiser, Concepts of Modern Physics, Tata McGraw-Hill, New Delhi, 1995.
2. A.J. Dekker, Solid State Physics, Mcmillan, 1986.

EN1011	ENGLISH LANGUAGE SKILLS I	3-0-0-3

Syllabus:

Basic Grammar: articles, quantifiers, punctuation, use of tenses, gerunds and infinitives, present participles, subject verb concord, adverbs, nouns, pronouns, prepositions, use of connectives, use of adjectives and adverbs; common errors; Lexicon- Enriching vocabulary through one-word substitutes, synonyms, antonyms, etc.

Spoken English: importance for effective communication; linguistic aspects of mishearing; fluency; speaking to multicultural/multidisciplinary audience; standard varieties of spoken English; understanding vowels, consonants and syllable in English; tempo of speech & phrasal pause in English; English rhythm; stress on simple and derived words in English; practice and learning to improve pronunciation of numbers, units of weights, distance, etc.

Aspects of Theatre in Spoken Communication: grooming, eye contact, body language, amplitude.

Preparing a Presentation: charts, graphs, drawings, maps, diagrams, tables, etc.; using power point slides and other presentation aids; making presentations and self-evaluation.

Texts:

1. Shreesh Chaudhary. Better Spoken English, New Delhi: Vikas Publishing. (1992/2004)
2. J. D. O'Connor. Better English Pronunciation, Cambridge University Press. (1980)
3. F.T. Wood. A Remedial English Grammar for Foreign Students. New Delhi: Macmillan. (1965)

References:

1. Marilyn Anderson, Pramod K. Nayar, and Madhucchanda Sen. Critical Reasoning, Academic Writing and Presentation Skills. Rev. ed. New Delhi: Longman-Pearson. (2010)
2. Oxford Advanced Learner's Dictionary of English, Ninth Edition. (2016)
3. Michael Swan and Catherine Walter. Oxford English Grammar Course: Advanced. Oxford: OUP. (2011)
4. Allan Pease and Barbara Pease. The Definitive Book of Body Language. New Delhi: Manjul Publishing House. (2005)

JA1011	JAPANESE LANGUAGE SKILLS I	3-0-0-3

Module I:	Introduction to Japanese language and scripts: Hiragana,Katakana, and Kanji. Introduction to Japanese pronunciation

	Culture Input: Useful everyday Japanese greetings and expressions with classroom vocabularies. Introduction to Japanese numerals.
Module II:	Learning self Introduction and how to connect with people. Talk about things using Japanese demonstratives.
Module III:	Learning how to tell time, and also to invite and accept invitation. Be able to perform basic actions in daily life.
Module IV:	Learning how to express likes and dislikes, simple thoughts and impressions about past events and experiences. Be able to express the existence of people and things.
Texts: 1. Minna No Nihongo Main Textbook Elementary1-2 (Goyal Publications) 2. Minna No Nihongo Translation and Grammatical Notes in English Elementary 1-2 (Goyal Publications) 3. Minna no Nihongo Shokyū 1 Kanji Eigo Ban (3A corporation) 4. Minna no Nihongo Shokyū 1 Hyōjun Mondai Shū (3A corporation) 5. Listening materials (3A corporation website)	

KO1011	KOREAN LANGUAGE SKILLS I	3-0-0-3
Module I:	Preliminaries I: Introduction to Korean language / Consonants & vowels / combining consonants & vowels. Preliminaries II : Final consonants / Reading practice / Basic expressions for the class	
Module II:	Greeting and introducing yourself. Asking and answering questions about daily life	
Module III:	Talking about where things are Buying things1 / Reading Sino-Korean numbers / Making requests	
Module IV:	Buying Things2 / Reading Pure Korean numbers /Quantifiers	
Texts: 1. Sejong Korean 1(King Sejong Institute Foundation, Seoul) & Workbook		

GE1091	YOGA FOR HOLISTIC HEALTH	0-0-2-1
Module I:	Inauguration: Introduction to the Course, Benefits of the Course, Ice-Breaking, Goal Setting, Team Building, The Power of Knowledge, The Power of Yoga & Meditation, Mental Relaxation Techniques. Capacity Building: Listening and Learning Enhancement, Questioning Skills, Communication Skills, The Latest Ipod (Inner Peace, Outer Dynamism) Introduction to Yoga: What's Yoga?, Benefits of Yoga, Limbs of Yoga, Obstacles to Yoga, Practicals (Yoga Asanas).	
Module II:	Yoga & Personality Development: Life Skills (Vastness of Life and Layers of Existence), Energy Management (Sources of Energy), Mind & Emotion Management, The Power of a Focussed Mind (Present Moment), Body - Breath - Mind	

	Connection (Importance of Breath), Introduction to Breathing Techniques, Practicals (Pranayams + Sudarshan Kriya). Mechanics of Happiness: Secret of Happiness, Stress Management (Sources of Stress, Physiology and Psychology of Stress), Handling Opposite Situations, Responsibility and Happiness Index, The Power of Responsibility, Living with Awareness (100%), Adaptability & Acceptance, Understanding Changing Nature of Life, Improving memory, concentration & focus, Concentration Pranayama, Practicals.
Module III:	Emotional Intelligence: Dealing with Worry/ Regret / Love/ Hate/ Fear/Regret/ Aversion, Anger Management, Time Management & Prioritization, Overcoming negative mental habits (i.e. complaining, gossiping, procrastination), Dealing with counterproductive habits, Lifestyle & Environment Awareness, Life Choices and their global consequences, Practicals. Self Confidence, Peer Pressure & Optimal Performance: Anxiety Management and Confidence, Personal and interpersonal relationship, Coping with Parental and Peer Pressure, Opinions, Inhibitions and their Impact on Life, Going Beyond Ego, The Ego-Handling Technique, Practicals.
Module IV:	Leadership: The Qualities of a Leader, The Role of Enthusiasm, Power of a Team, The Power of Intention, Intention, Attention, Manifestation, Commitment, Practicals. Ethics, Morality and Integrity: Importance of ethics, morals and integrity, Human Values, Social Code of Conduct, Role Models of Integrity, Role of youth in nation building, Practicals. A Vision for A Stress-free, Violence-free World: Spreading Happiness, Happiness Survey, The Concept of Social work, Brainstorming for Team Service Projects, Anti-Drug Awareness Campaign, Break into Service, Practical.
TEXT BOOK:	1. Commentary on the Patanjali Yoga Sutras 2. Wisdom for Life

GE1092	I	NDUCTION PROGRAMME (Audit)	0-0-2-1
Physical activity Creative Arts Universal Human Values Literary Proficiency Modules Lectures by Eminent People Visits to local Areas			

Familiarization to Dept./Branch & Innovations

SEMESTER-II

Sem.	Course code	Course Name	L	T	P	C
II	MA1012	Mathematics II	3	1	0	4
II	CS1012	Data Structures	3	0	0	3
II	CS1112	Data Structures Lab	0	0	2	1
II	EC1013	Basic Electronic Circuits	3	0	0	3
II	EC1112	Basic Electronic Circuits Lab	0	0	2	1
II	PH1012	Physics II	3	0	0	3
II	EN1012	English Language Skills II	3	0	0	3
	JA1012	Japanese Language Skills II				
	KO1012	Korean Language Skills II				
II	HS1091	HSS-I (Introduction to Entrepreneurship)	3	0	0	3
		Total	18	1	4	21
		Contact Hours / Week	23			

Humanities & Social Science	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total
6	7	8	0	0	0	0	0	21

MA1012	MATHEMATICS II	3-1-0-4

Syllabus:

Multivariable Calculus: Vector functions of one variable – continuity, differentiation and integration; functions of several variables - continuity, partial derivatives, directional derivatives, gradient, differentiability, chain rule; tangent planes and normals, maxima and minima, Lagrange multiplier method; repeated and multiple integrals with applications to volume, surface area, moments of inertia, change of variables; vector fields, line and surface integrals; Green's, Gauss's and Stokes' theorems and their applications.

Ordinary Differential Equation: First order differential equations - exact differential equations, integrating factors, Bernoulli equations, existence and uniqueness theorem, applications; higher-order linear differential equations - solutions of homogeneous and non-homogeneous equations, method of variation of parameters, Laplace and inverse Laplace transforms; properties, convolutions; solution of ODE by Laplace transform. Systems of first-order equations, two-dimensional linear autonomous system, phase plane, critical points, stability.

Texts:

1. G. B. Thomas, Jr. and R. L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson Education India, 1996.
2. S. L. Ross, Differential Equations, 3rd Edition, Wiley India, 1984.

References:

1. H. Anton, I. C. Bivens and S. Davis, Calculus, 10th Edition, Wiley, 2011.
2. T. M. Apostol, Calculus, Volume 2, 2nd Edition, Wiley India, 2003.
3. W. E. Boyce and R. C. Di Prima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
4. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.

CS1012	DATA STRUCTURES	3-0-0-3

Syllabus:

Performance of algorithms: space and time complexity, asymptotic;

Basic data structure: Linked list (singly, doubly, circular), stacks, queue (circular, priority, dqueue)

Sorting & searching: Insertion sort, selection sort, bubble sort, quicksort, mergesort, heapsort, shellsort, linear search;

Nonlinear data structure: Tree (Representation, binary tree (full, complete, balance), binary search tree), tree traversals (post, in, pre), red-black tree, AVL tree

Advanced structure: Heap (max, min, binomial, fibonacci), hash (Chaining, Linear probing, Quadratic probing, Hash tree);

Graphs: Representations (Adjacency Matrix, Adjacency list), Depth first search, Breadth first search;

Text:

1. A H Aho, J E Hopcroft and J Ullman, Data Structures and Algorithms, Addison-Wesley, 1987.

References:

1. M A Weiss, Data Structures and Problem-Solving Using Java, Addison-Wesley, 1997.
2. A M Tannenbaum, Y Langsam and M J Augenstein, Data Structures Using C++, Prentice Hall India, 1996.
3. Robert Sedgewick, Algorithms in C++ Parts 1-5, Pearson Education, Third Edition, 1998.
4. Seymour Lipschutz, Data Structures with C, SCHAUM SERIES, Tata McGraw-Hill, 1st edition, 2010.
5. Horowitz, Sahni, and Anderson-Freed, Fundamentals of Data Structures in C, Universities Press

CS1112	DATA STRUCTURE LAB	0-0-2-1

Implementation of the following algorithms with operations are mandatory using C/C++ programming language (preferably using functions to make it modular). Instructor may take help of application-specific mini-projects (a set of input will be transformed to output) to explain the concept of these data structures.

Basic data structure: Linked list (singly, doubly, circular), stacks, queue (circular, priority, dqueue)

Sorting & searching: Insertion sort, selection sort, bubble sort, quicksort, mergesort, heapsort, shellsort, linear search;

Nonlinear data structure: Tree (Representation, binary tree (full, complete, balance), binary search tree), tree traversals (post, in, pre), red-black tree, AVL tree

Advanced structure: Heap (max, min, binomial, fibonacci), hash (Chaining, Linear probing, Quadratic probing, Hash tree);

Graphs: Representations (Adjacency Matrix, Adjacency list), Depth first search, Breadth first search;

References:

1. A H Aho, J E Hopcroft and J Ullman, Data Structures and Algorithms, Addison-Wesley
2. Horowitz, Sahni, and Anderson-Freed, Fundamentals of Data Structures in C, Universities Press
3. Seymour Lipschutz, Data Structures with C, SCHAUM SERIES, Tata McGraw-Hill
4. M A Weiss, Data Structures and Problem-Solving Using Java, Addison-Wesley
5. Robert Sedgewick, Algorithms in C++ Parts 1-5, Pearson Education, Third Edition

EC1013	BASIC ELECTRONIC CIRCUITS	3-0-0-3

Syllabus:

Course Topics - Examples of Electronic Systems: Music System, Radio, Television

Diodes and Applications: Semiconductor diode - ideal versus practical, resistance levels, diode equivalent circuits, load line analysis; diode as a switch, diode as a rectifier, half wave and full wave rectifiers with and without filters; clipping circuits, clamper circuits, breakdown mechanisms, Zener diode – operation and applications; regulated d-c power supply.

Transistor Characteristics: Bipolar junction transistor (BJT) – construction, operation, amplifying action, common base, common emitter and common collector configurations, operating point, voltage divider bias configuration; Differential Amplifier.

Operational Amplifiers and Applications: Introduction to op-amp, characteristics of ideal op-amp, controlled source models, classification, the operational amplifier (op-amp) as a linear active device, the VCVS model of an op-amp, different amplifier configurations using op-amp, concept of virtual ground; op-amp operations, integrator and differentiator, frequency response of op-amp and op-amp based amplifiers. CMRR, PSRR, slew rate; pin configuration of 741 op-amp

Filters: Concepts of low-pass, high-pass and band-pass filters, ideal (brick-wall) filter response, frequency response of simple RC filters, active RC filters using Op-amp.

Oscillators: Effects of negative and positive feedback of an amplifier, condition of harmonic oscillation, RC and LC oscillator circuits.

Comparator: Op-amp as a comparator, digital inverters (TTL/CMOS) as comparators, comparator with hysteresis, Schmitt trigger using Op-amp, 555 timer as a two dimensional comparator. Waveform generators: Concept of bistable, monostable and astable circuits, timer and relaxation oscillator based on comparator and RC timing circuit, square wave generator using 555 timer, crystal clock generator.

Data Converters: Sample and hold circuits, Digital to Analog Converter (DAC) using binary resistor scheme, R-2R ladder DAC, DAC using switched current resources, Analog to Digital converter (ADC) using capacitor charge/discharge: single-slope and dual-slope ADCs, ADC using counter and DAC, ADC using successive approximation.

Texts:

1. Albert Malvino and David Bates, Electronic Principles, McGraw Hill Education; 2015.

References:

1. R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, 2013.
2. Jacob Millman, Christos Halkias, Chetan Parikh, Millman's Integrated Electronics - Analog and Digital Circuit and Systems, McGraw Hill Education; 2017
3. Adel S. Sedra, Kenneth C. Smith & Arun N. Chandorkar, Microelectronic Circuits, International Version 6th Edition, 2013, Oxford University Press India

EC1112	BASIC ELECTRONICS LAB	0-0-2-1

Experiments using diodes: Diode characteristics, design and analysis of half-wave and full-wave rectifier circuits without and with filter, clipping circuits, clamper circuits,

Experiments using operational amplifier: Inverting amplifier, non-inverting amplifier, voltage follower, integrator, differentiator, comparators, Multivibrators, Wien's Bridge Oscillator, first-order filters, D/A and A/D converters.

PH1012	PHYSICS II	3-0-0-3

Syllabus:

Vector Calculus: Gradient, Divergence and Curl, Line, Surface, and Volume integrals, Gauss's divergence theorem and Stokes' theorem in Cartesian, Spherical polar and cylindrical polar coordinates, Dirac Delta function.

Electrostatics: Gauss's law and its applications, Divergence and Curl of Electrostatic fields, Electrostatic Potential, Boundary conditions, Work and Energy, Conductors, Capacitors, Laplace's equation, Method of images, Boundary value problems in Cartesian Coordinate Systems, Dielectrics, Polarization, Bound Charges, Electric displacement, Boundary conditions in dielectrics, Energy in dielectrics, Forces on dielectrics.

Magnetostatics: Lorentz force, Biot---Savart and Ampere's laws and their applications, Divergence and Curl of Magnetostatic fields, Magnetic vector Potential, Force and torque on a magnetic dipole, Magnetic materials, Magnetization, Bound currents, Boundary conditions.

Electrodynamics: Ohm's law, Motional EMF, Faraday's law, Lenz's law, Self and Mutual inductance, Energy stored in magnetic field, Maxwell's equations, Continuity Equation, Poynting Theorem, Wave solution of Maxwell Equations.

Electromagnetic waves: Polarization, reflection & transmission at oblique incidences.

Texts:

1. Introduction to Electrodynamics by D. J. Griffiths, 3rd Ed., Prentice Hall of India, 2005.
2. Elements of Electromagnetics by M. N. O. Sadiku, Oxford, 2006.

References:

1. C. A. Balanis, Advanced Engineering Electromagnetics, 2nd Edition, John Wiley, 2012.
2. The Feynman Lectures on Physics, Vol.II by R. P. Feynman, R. B. Leighton and M. Sands, Narosa Publishing House, 1998.

HS1091	INTRODUCTION TO ENTREPRENEURSHIP	3-0-0-3

Syllabus:

Meaning and Importance, Evolution, influencing factors (Psychological, Social, Economic, Environmental), Characteristics, Types of entrepreneur (based business, technology, motivation, growth, stages), Myths & Barriers.

Meaning and concept of E-cells, advantages to join E-cell, significance of E-cell, various activities conducted by E-cell, case studies (including success and failure stories) and comparative analysis, Rules And Legislation (Applicability of Legislation; Industries Development (Regulations) Act, 1951; Factories Act, 1948; The Industrial Employment (Standing Orders) Act, 1946; Suspension; Stoppage of work; Termination of employment; Environment (Protection) Act, 1986; The sale of Goods Act, 1950; Industrial Dispute Act 1947; GST; Central Excises Act, 1944

Why to become entrepreneur, the skills/ traits required to be an entrepreneur, Creative and Design; Thinking, the entrepreneurial decision process, skill gap analysis, and role models, mentors and support; system,Introduction to various form of business organization (sole proprietorship, partnership; corporations, Limited Liability company), mission, vision and strategy formulation.

Assistance to an entrepreneur: Industrial Park (Meaning, features, & examples), Special Economic Zone (Meaning, features & examples), Financial assistance by different agencies, MSME Act Small Scale Industries, Carry on Business (COB) license, Environmental Clearance, National Small Industries Corporation (NSIC), Government Stores Purchase scheme (e-tender process), Excise exemptions and concession, Exemption from income tax, Quality Standards with special reference to ISO, Small Industries Development Bank of India (SIDBI), State Small Industries Development Corporation (SSIDC), Directorate General of Supplies and Disposals, Khadi and Village Industries Commission (KVIC)

Importance of communication, barriers and gateways to communication, listening to people, the power of talk, personal selling, risk taking \& resilience, negotiation.

Text:

1. Introduction to Entrepreneurship, Commonwealth of Learning; http://oasis.col.org/bitstream/handle/11599/2465/2011_VUSSC_Intro-to-Entrepreneurship.pdf?sequence=1&isAllowed=y

References:

1. Entrepreneurship, Michael Laverty & Chris Littel, https://openstax.org/books/entrepreneurship/pages/preface

2. Introduction to Entrepreneurship; Katherine Carpenter, University of Victoria; https://open.umn.edu/opentextbooks/textbooks/introduction-to-entrepreneurship

EN1012	ENGLISH LANGUAGE SKILLS II	3-0-0-3

Syllabus:

Introduction to Communication: need for effective communication; the process of communication; significance of technical communication; barriers to communication.

Listening Skills: listening as an active skill; listening for specific information; developing effective listening skills; barriers to effective listening skills.

Reading Skills: skimming; scanning; understanding the gist of an argument; identifying the topic sentence; inferring lexical and contextual meaning.

Writing Skills: sentence formation; use of appropriate diction; paragraph and essay writing; coherence and cohesion; technical writing; letter writing; job application; report writing.

Speaking Skills: non-verbal communication; group discussion; presentation skills; technology-based communication.

Texts:

1. V.N. Arora and Lakshmi Chandra. Improve Your Writing. New Delhi: OUP, 1981.
2. Marilyn Anderson, Pramod K. Nayar, and Madhucchanda Sen. Critical Reasoning, Academic Writing and Presentation Skills. Rev. ed. New Delhi: Longman-Pearson, 2010.
3. Allan Pease and Barbara Pease. The Definitive Book of Body Language. New Delhi: Manjul Publishing House, 2005.

References:

1. F.T. Wood. A Remedial English Grammar for Foreign Students. New Delhi: Macmillan, 1965.
2. Nitin Bhatnagar and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson.
3. N. Krishnaswami and T. Sriraman. Current English for Colleges. Chennai: Macmillan, 1990.

4. N. Krishnaswami and T. Sriraman. Creative English for Communication. 2nded. New Delhi: Macmillan, 2009.
5. Michael Swan. Practical English Usage. 3rd ed. Oxford: OUP, 2005.
6. Michael Swan and Catherine Walter. Oxford English Grammar Course: Advanced. Oxford: OUP, 2011.

JA1012	JAPANESE LANGUAGE SKILLS II	3-0-0-3
Module I:	Be able to express one's wants and desires, also be able to give simple requests, instructions and recommendations. Be able to understand prohibitions and rules, and also to be able to describe people, things, places, etc.	
Module II:	Be able to talk easily about potential and hobbies. Also be able to express the transformation of things and people.	
Module III:	Be able to understand the difference between polite and informal sentences, as well as to be able to use casual sentences and the context. Be able to use indirect sentences	
Module IV:	Be able to explain what action to perform at what time.Deeper understanding of the usage of respected forms of Japanese .Be able to use conditional forms.	
Texts: 1. Minna No Nihongo Main Textbook Elementary1-2 (Goyal Publications) 2. Minna No Nihongo Translation and Grammatical Notes in English Elementary 1-2 (Goyal Publications) 3. Minna no Nihongo Shokyū 1 Kanji Eigo Ban (3A corporation) 4. Minna no Nihongo Shokyū 1 Hyōjun Mondai Shū (3A corporation) 5. Listening materials (3A corporation website)		

KO1012	KOREAN LANGUAGE SKILLS II	3-0-0-3
Module I:	Talking about the past Talking about Seasons and Weather / Negating	
Module II:	Asking and telling the date, day, and time Making suggestions/promises	
Module III:	Asking and answering about weekend activities Talking about studying Korean	
Module IV:	Talking about future plans	
Texts: 1. Sejong Korean 1(King Sejong Institute Foundation, Seoul) & Workbook		

SEMESTER-III

Sem.	Course Code	Course Name	L	T	P	C
III	MA2013	Probability and Random Processes	3	0	0	3
III	EC2031	Signals and Systems	3	0	0	3
III	EC2131	Signals and Systems Lab	0	0	2	1
III	EC2021	Semiconductor Devices	3	0	0	3
III	EC2022	Analog Circuits	3	0	0	3
III	EC2122	Analog Circuits Lab	0	0	2	1

III	CS2013	Object Oriented Programming	3	0	0	3
III	CS2113	Object Oriented Programming Lab	0	0	2	1
III	ECXXX	Microcontroller and Microprocessor	3	1	0	4
		Total	18	0	8	22
		Contact Hours / Week	26			

Humanities & Social Science (HS)	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total
0	3	12	7	0	0	0	0	22

MA2013	PROBABILITY AND RANDOM PROCESSES	3-0-0-3

Syllabus:

Introduction to probability: mathematical background - sets, set operations, sigma and Borel fields; classical, relative-frequency and axiomatic definitions of probability; conditional probability, independence, total probability, Bayes rule; repeated trials;

Random variables: Cumulative distribution function, continuous, discrete and mixed random variables, probability mass function, probability density functions; functions of a random variable; expectation - mean, variance and moments; characteristic and moment-generating functions; Chebyshev, Markov and Chernoff bounds; special random variables-Bernoulli, binomial, Poisson, uniform, Gaussian and Rayleigh; joint distribution and density functions; Bayes rule for continuous and mixed random variables; joint moments, conditional expectation; covariance and correlation- independent, uncorrelated and orthogonal random variables; function of two random variables; sum of two independent random variables; random vector- mean vector and covariance matrix, multivariate Gaussian distribution; Vector-space representation of Random variables, laws of large numbers, central limit theorem;

Random process: discrete and continuous time processes; probabilistic structure of a random process; mean, autocorrelation and autocovariance functions; stationarity- strict-sense stationary and wide-sense stationary (WSS) processes: autocorrelation and cross-correlation functions; time averages and ergodicity; spectral representation of a real WSS process-power spectral density, cross-power spectral density, Wiener Khinchin theorem, linear time-invariant systems with WSS process as an input time and frequency domain analyses; spectral factorization theorem;

Examples of random processes: white noise, Gaussian, Poisson and Markov processes, Basics of Queuing Theory, Characteristics of queuing systems.

Texts:

1. Papoulis and S.U. Pillai, Probability Random Variables and Stochastic Processes, 4/e, McGraw-Hill, 2002.
2. A. Leon Garcia, Probability and Random Processes for Electrical Engineering, 2/e, Addison-Wesley, 1993.

References:

1. H. Stark and J.W. Woods, Probability and Random Processes with Applications to Signal Processing, 3/e, Prentice Hall, 2002.
2. John J. Shynk, Probability, Random Variables, and Random Processes: Theory and Signal Processing Applications, 1/e, Wiley publications, 2012.

EC2031	SIGNALS AND SYSTEMS	3-0-0-3

Syllabus:

Signals: Signal Basics, Elementary signals, classification of signals; signal operations: scaling, shifting and inversion; signal properties: symmetry, periodicity and absolute integrability; Sampling and Reconstruction, Sampling and Nyquist theorem, aliasing, signal reconstruction: ideal interpolator, zero-order hold, first-order hold; Sinc function, Practical reconstruction, group delay, phase delay.

Systems: classification of systems; Time-Domain Analysis of Continuous-Time Systems; system properties: linearity, time/shift-invariance, causality, stability; continuous-time linear time invariant (LTI) and discrete-time linear shift invariant (LSI) systems: impulse response and step response; response to an arbitrary input: convolution; circular convolution; system representation using differential equations; Eigen functions of LTI/ LSI systems, frequency response and its relation to the impulse response; correlation and cross correlation of two sequences.

Signal representation: signal space and orthogonal basis; continuous-time Fourier series and its properties; continuous-time Fourier transform and its properties; Parseval's relation, time-bandwidth product; discrete time Fourier series; discrete-time Fourier transform and its properties; relations among various Fourier representations. Linear Convolution using DFT. Fast Fourier Transform (FFT);

Laplace transform and properties, Inverse Laplace Transform by Partial Fraction and Z-transform: definition, region of convergence, properties; transform-domain analysis of LTI/LSI systems, system function: poles and zeros; stability, inverse Z-Transform by Partial Fraction.

Text:

1. M. J. Roberts," Fundamentals of Signals and Systems", 1st Edition, Tata McGraw Hill, 2007.
2. A.V. Oppenheim, A.S. Willsky and H.S. Nawab," Signals and Systems", 2nd Edition Prentice Hall of India, 2006.

References:

1. R.F. Ziemer, W.H. Tranter and D.R. Fannin," Signals and Systems - Continuous and Discrete", 4th Edition, Prentice Hall, 1998.
2. Simon Haykin, Barry van Veen," Signals and Systems", 2nd Edition, John Wiley and Sons, 1998.
3. TarunRawat, "Signals and Systems", Oxford University Press.

EC2131	SIGNALS AND SYSTEMS LAB	0-0-2-1

Syllabus:

Introduction to computation platforms: GNU Octave, SciLab, MATLAB.

Signals: Generation of Continuous and Discrete time signals (Unit step, Impulse, Ramp, Exponential and Sinusoidal etc.); simulation of basic operations on signals (Folding, scaling, shifting, addition, subtraction, multiplication etc.); finding the even and odd parts of a signal; computing whether the given system is linear or not; computation of Sampling theorem;

Systems: Computation of output response of two sequences x(n) and h(n) using: a) Linear Convolution, b) Circular Convolution, c) Circular Convolution with zero padding; computation of Cross correlation of two sequences; Signal representation: Fourier Series Evaluation for Square Wave Function; Discrete Time Fourier Transform (DTFT); DFT and IDFT of the sequences x(n) and X(k); computation of L-transform transfer function for a given input; computations of Z-transform transfer function for a given input.

Reference:

1. V. K. Ingle and J. G. Proakis, "Digital Signal Processing with MATLAB", Cengage, 2008.

EC2021	SEMICONDUCTOR DEVICES	3-0-0-6

Syllabus:

Brief discussion of quantum theory of solids: energy bands, electrical conduction in solids, formation of Fermi-Dirac probability function using the concepts of statistical mechanics and k-space diagram.

Semiconductors in equilibrium: charge carrier profile in intrinsic and extrinsic semiconductor, behavior of Fermi energy level with varying temperature and doping concentration.

Carrier transport in semiconductors: drift current and diffusion current, Hall Effect. Semiconductors in non-equilibrium condition: carrier generation and recombination, continuity equation, ambipolar transport.

P-N junction: under zero applied bias and reverse bias, comparative study of abrupt junction and linearly graded junction, qualitative and quantitative discussion of p-n junction current, small signal model of p-n junction, junction breakdown and Tunnel diode.

Behavior of metal semiconductor junction: Schottky barrier diode, metal-semiconductor ohmic contact.

Bipolar transistor: basic principles of operation, carrier distribution under different modes of operation, non-ideal effects, frequency limitations. Fundamentals of MOSFET, capacitance-voltage characteristics, current voltage relationship, frequency limitations

Text:

1. Donald A. Neamen, Semiconductor Physics and Devices, Tata McGraw Hill, 3rd Edition.

References:

1. Ben G. Streetman, Solid State Electronic Devices, PHI, 5/e, 2001.
2. J. Singh, Semiconductor Devices - Basic Principles; John Wiley & Sons Inc., 2001.
3. Simon M. Sze, Kwok K. Ng, Physics of Semiconductor Devices, Wiley, 3/e, 2006/7.

EC2022	ANALOG CIRCUITS	3-0-0-3

Syllabus:

Review of working of BJT, JFET and MOSFET and their small signal equivalent circuits both for low and high frequencies; Different types of biasing for BJT and MOSFET, Bias Compensation, Thermal Stabilization; Single stage amplifiers CE-CB-CC and CS-CG-CD;

Multistage amplifiers: RC Coupled, Direct Coupled amplifier and their frequency responses;

Differential amplifiers: DC and small signal analysis, CMRR, current mirrors, active load and cascade configurations, frequency response; case study: 741 op-amp – DC and small signal analysis, frequency response, frequency compensation, GBW, phase margin, slew rate, offsets;

Feedback amplifiers: basic feedback topologies and their properties, analysis of practical feedback amplifiers, stability and Transistor based Oscillator;

Power Amplifiers: class A, B, AB, C, D, E stages, output stages, short circuit protection, power transistors and thermal design considerations, Tuned Amplifier;

Filters: Butterworth, Chebyshev and elliptic, first order and second order passive/active filter realizations.

Text:

1. Adel S. Sedra, Kenneth C. Smith &Arun N. Chandorkar, Microelectronic Circuits, International Version 6th Edition, Oxford University Press India, 2013.

References:

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 11th Edition, Pearson Education, 2015.
2. P. Gray, P. Hurst, S. Lewis and R. Meyer, Analysis &Design of Analog Integrated Circuits, 5/e, Wiley, 2009.
3. Millman,Halkias, Parikh – Integrated Electronics, 2/e,Penguin Books Ltd, 2009.
4. Sergio Franco - Design with Operational Amplifiers and Analog Integrated Circuits, 3/e, McGraw Hill Book Company, 2001

EC2122	ANALOG CIRCUITS LAB	0-0-2-1

Syllabus:

Experiments using BJTs: BJT characteristics in different configurations, hybrid parameters, single-stage and multistage BJT amplifiers, effect of negative feedback; experiments using FETs: FET characteristics, FET amplifiers.

CS2013	OBJECT ORIENTED PROGRAMMING	3-0-0-3

Syllabus:

Review of programming practices and code-reuse; Object model and object-oriented concepts: Data Abstraction: Class, object, constructors, destructors, memory allocations for objects, member functions, friend functions, templates. Inheritance: Single & multiple inheritance, virtual base class. Polymorphism: Compile time polymorphism: operator overloading, function overloading, static binding. Run-time polymorphism: Virtual function, pure virtual function, abstract class, dynamic binding. Exception handling. Object-oriented programming languages and implementation. File handling.

Texts:

1. E Balaguruswamy: Object Oriented Programming with C++, McGraw Hill
2. Grady Booch: Object Oriented Analysis and Design, Pearson Education.

References:

1. Herbert Schild: The Complete Reference to C++, Osborne Mc Graw Hill.
2. Bertrand Meyer, Object Oriented Software Construction, Prentice-Hall.
3. Bjarne Stroustrup: The C++ Programming Language, Addison Wesley
4. Rambaughet al.: Object Oriented Modeling and Design, PHI(EEE).

CS2113	OBJECT ORIENTED PROGRAMMING LAB	0-0-2-1

Lab Assignment:

Implementation of class and Object creation, Constructors, Abstract classes and Abstract methods, Inheritance, overloading- operator & function, Exception Handling, Packages, File Handling, Multi-Threading, Graphic Classes

Reference Book:

1. Grady Booch: Object Oriented Analysis and Design, Pearson Education.
2. E Balaguruswamy : Object Oriented Programming with C++, McGraw Hill
3. Herbert Schild : The Complete Reference to C++, Osborne Mc Graw Hill.
4. Bjarne Stroustrup: The C++ Programming Language, Addison Wesley
5. Bertrand Meyer, Object Oriented Software Construction, Prentice-Hall.

EC2071	MICROCONTROLLER AND MICROPROCESSOR	3-1-0-4

Microprocessors: Evolution of Microprocessors, Basic functional blocks of a microprocessor, microprocessor-based systems, concept of multiplexing in microprocessor.

Architecture of 8-bit Microprocessor: Intel 8085/8086 microprocessor, pin description and internal architecture, comparison with 8-bit processor.

Instruction Set of x86: Assembly language fundamentals, Machine cycles, instruction format, addressing modes, instruction set, classification, Data Transfers instructions, arithmetic and logical instructions, String manipulating instructions, control transfer instructions, processor control instructions, flags, assembly language programming using 8086.

Peripheral Devices and Interfacing: Memory and I/O interfacing, 8255 Interfacing examples, interfacing of DC and stepper motors, interfacing of key board, display, USART.

Lab Assignments:

Software experiments using an 8085/8086 Kit to learn its instruction set. Hardware experiments for the use of peripherals like 8251 (USART). Experiments to learn Port IO, control of on chip peripherals such as timers, interfacing with off chip peripherals such as LCD displays, Key boards, Stepper motors and ADC chips. Experiments for the use of other microcontrollers such as PIC using development boards.

Text:

1. R.S. Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085, Penram International Publishing, Fifth Edition, 2011.

References:

1. Nagoor Kani, Microprocessors and Microcontrollers, The McGraw-Hill Companies, 2nd Edition
2. J.H. Hennessy, and D.A. Patterson, Computer Architecture: A Quantitative Approch, Morgan Kaufmann Publishers, Fourth Edition, 2006.
3. Kenneth J. Ayala, The 8051 Microcontroller, Architecture, Programming and Applications, Penram International Publishing, 1996.
4. Hall D. V., “Microprocessor and Interfacing-Programming and Hardware”, 2nd Ed., Tata McGraw-Hill Publishing Company Limited, 2008

SEMESTER-IV

Sem.	Course code	Course Name	L	T	P	C
IV	EC2014	Electromagnetic Theory	3	0	0	3
IV	EC2042	Principles of Communication	3	0	0	3
IV	EC2114	Principles of Communication Lab	0	0	2	1
IV	EC2032	Digital Signal Processing	3	0	0	3
IV	EC2132	Digital Signal Processing Lab	0	0	2	1
IV	ECXXX	Measurement and Instrumentation	3	0	0	3
IV	CS2041	Operating Systems	3	0	0	3
IV	CS2141	Operating Systems Lab	0	0	2	1
IV	EC3081	Control Systems	3	1	0	4
		Total	18	1	6	22
		Contact Hours / Week	25			

Humanities & Social Science (HS)	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total
0	0	4	18	0	0	0	0	22

4th Semester	**EC2014: ELECTROMAGNETIC THEORY**	**Core**
Objectives:	This is a Core UG course that is necessary for follow up courses on high speed digital design, RF and microwave, fiber optics and antennas. This course is intended to be an application-oriented course while covering all the theoretical concepts of modern electromagnetics. It begins by an in-depth study of transmission lines, which are crucial for the signal integrity of PCBs and high-speed digital design. The course covers analytical and numerical solution of Laplace's and Poisson's equations, quasi-static analysis of capacitors and the skin effect, inductance calculations, and Maxwell equations after a brief review of the relevant mathematics (coordinate systems, vector analysis, and vector fields). Waveguides (rectangular, planar dielectric, and optical fibers) and antennas are discussed along with wave propagation in free-space and ferrites media. There is a good mix of theory, programming, and applications throughout the course. MATLAB/ GNU Octave simulation exercises will be added to the course. The course is framed as per the GATE Syllabus.	
Course Outcomes	• Understanding and application of Transmission Line Theory. • Understanding of EM waves propagation in terms of Maxwell's equations. • Understanding of EM waves propagation in Waveguides (rectangular, planar dielectric, and optical fibers). • To apply fundamental electromagnetic concepts in applications such as Transmission Lines and Antennas. • To apply fundamental numerical techniques to solve fundamental electromagnetic problems. • To use MATLAB/ GNU Ocatve to solve simple EM problems: Solution of Laplace's and Poisson's equation.	
Prerequisites:	Electricity and magnetism at the level of Engineering Physics, Vector analysis, Differential and integral calculus, programming using Matlab/ GNU Ocatve (preferable).	
Module	Syllabus	No. of

		Lectures
I	Review of Coordinate Systems and Vector Analysis: Complex Numbers, Phasors, Vector Arithmetic, Coordinate System and Transformations, Contours (Cartesian, Cylindrical, and Spherical), Surfaces (Cartesian, Cylindrical, and Spherical), Volume, Gradient, Divergence, and Curl.	3
II	Introduction to Applied EM theory, Lossless Transmission line equations, Frequency-domain behaviour: Characteristic impedance of T-line, Reflection and transmission coefficients, Complete solution for sinusoidal propagation, Attenuation and propagation coefficients Transmission line techniques: Standing wave ratio (SWR) and line impedance, Visual aid: Smith Chart derivation, Smith chart applications: Impedance to admittance conversion, SWR and impedance calculation, Impedance matching techniques, T-lines in time-domain: Reflection from mismatched loads, Case study: High-speed digital signals on PCBs	13
III	Vector fields, Overview and importance of Maxwell's equations, Boundary conditions between two media, Solution of Laplace's and Poisson's equation – Analytical techniques, Solution of Laplace's and Poisson's equation in two dimensions, Numerical solution of Laplace's equation: Finite difference method, Quasi-statics: Does an ideal capacitor exist? Magnetostatic fields: Biot Savart and Ampere's laws, Magnetic field calculations, Inductance and inductance calculation, Quasi-statics: Fields of a wire, Quasi-static analysis of skin effect.	10
IV	Uniform plane waves – one dimensional wave equation, Uniform plane waves: propagation in arbitrary direction, phase velocity, polarization, Plane waves in conductors a dielectric media, Reflection and transmission of plane waves at a planar interface, Oblique incidence and reflection of plane waves – s and p polarization, Total internal reflection and Snell's laws. Waveguides – General introduction, Rectangular and Circular metallic waveguide modes, Dispersion and attenuation, Dielectric planar waveguides, Case study: Optical fibers, Application: Fiber-optic communications, WDM optical components. Wave propagation in Ferrites, Wave propagation in periodic structures: Diffraction, Vector potential and wave equation, Radiation by dipole and monopole.	16
Text:	1. J. D. Kraus and D. Fleisch, "Electromagnetics with applications", 5th Edition, McGraw Hill, 1999	
References:	1. Hayt and Buck, "Engineering Electromagnetics", 7th Edition, McGraw Hill. 2. D. Staelin, A. Morgenthaler, and J. A. Kong, "Electromagnetic waves", Pearson, Pearson, 1993. 3. S. M. Wentworth, "Applied Electromagnetics: Early Transmission Line Approach", Wiley, 2007. 4. D. Misra, "Practical Electromagnetics", Wiley, 2007. 5. M. N. O. Sadiku, "Principles of Electromagnetics", 4th Edition, Oxford University Press, 2007. 6. David J Griffiths, "Introduction to Electrodynamics", 4th Edition, Pearson, 2013. 7. M. N. O. Sadiku, "Numerical Techniques in Electromagnetic", 2nd Edition, CRC Press, 2000. 8. D. K. Cheng, "Field and Wave Electromagnetics", 2nd Edition, Pearson, 2001. 9. E. Lonngren and S. V. Savov, Fundamentals Electromagnetics with MATLAB, 1st Edition. PHI, 2005. 10. C. A. Balanis, "Advanced Engineering Electromagnetics", 2nd Edition, John Wiley, 2012. 11. D. M. Pozar, "Microwave Engineering", 4th Edition., John Wiley and Sons Inc.	

4th Semester	**EC2042: PRINCIPLES OF COMMUNICATION**	**Core**
Objectives:	• To introduce students to the basic principles and concepts of analog communication, including analog modulation techniques, transmission, reception, and noise effects.	

	• Know the techniques of analog communication and noise analysis in analog communication. • To teach students how digital signals are generated, transmitted, and received. This includes learning about sampling, quantization, and various signal processing techniques used in digital communication systems.	
Prerequisites:	Signal and Systems	
Module	Syllabus	No. of Lectures
I	Review of Signals and Systems: Signals; Periodic and Aperiodic Signals; Energy and Power Signals; Deterministic and Random Signals; Dirac Delta function; Linear time-invariant systems; Fourier-series; Fourier-transform and its properties; Auto correlation of signals; Energy spectral density; Parseval's relation; Power spectral density; Baseband and passband signals; The structure of a pass band signal; Hilbert transform;	10
II	Introduction to Communication: Basic elements of a communication system; Digital communication system; Communication channels and their characteristics; Modulation; Need of modulation; Amplitude Modulation and Demodulation: Conventional amplitude modulation (AM); Double-sideband suppressed carrier (DSB-SC) modulation; Quadrature carrier multiplexing (QCM); Single-sideband modulation (SSB); Vestigial-sideband (VSB) modulation; Implementation of AM modulator and demodulator; Frequency division multiplexing;	12
III	Angle Modulation and Demodulation: Phase modulation (PM); Frequency modulation (FM); Spectrum of an FM signal; Bandwidth of FM signal; Narrowband FM; Wideband FM; FM generation; FM detectors; The super-heterodyne receiver; The phase-locked loop (PLL) and its application; Noise in Analog Communication System: Thermal noise; Noise temperature; Noise figure; Effect of Noise performance of baseband system; Noise in amplitude modulated systems; Noise in angle modulated systems; Pre-emphasis and De-emphasis;	13
IV	Digital Representation of Analog Signals: Introduction to sampling; Spectrum of sampled signal, Aliasing and Nyquist sampling theorem; Reconstruction of original signal from sampled signal; Pulse amplitude modulation (PAM); Pulse position modulation (PPM); Pulse width modulation(PWM); Introduction to quantization; Uniform quantizer; Mid-tread quantizer; Mid-rise quantizer; Quantization noise; Lloyd- Max quantization algorithm; Non uniform quantizers; Delta modulation; Adaptive Delta Modulations; Differential pulse code modulation (DPCM).	9
Text:	1. John G. Proakis and MasoudSalehi, Communication Systems Engineering, 2nd Edition, Pearson Education, 2002.	
References:	1. B. P. Lathi, Modern Digital and Analog Communication Systems, 3rd Edition, Oxford Univ. Press, 2006. 2. Simon Haykin, Communication Systems, 4th Edition, John Wiley, 2001. 3. Upamanyu Madhow, Introduction to Communication Systems, Cambridge University Press, 2014.	

EC2114	PRINCIPLES OF COMMUNICATION LAB	0-0-2-1
Syllabus:		

1.
1.

EC2032	DIGITAL SIGNAL PROCESSING	3-0-0-3

Syllabus:

Frequency selective filters: Ideal filter characteristics, lowpass, highpass, bandpass and bandstop filters, Paley-Wiener criterion, digital resonators, notch filters, comb filters, all-pass filters, inverse systems, minimum phase, maximum phase and mixed phase systems.

Structures for discrete-time systems: Signal flow graph representation, basic structures for FIR and IIR systems (direct, parallel, cascade and polyphase forms), transposition theorem, ladder and lattice structures.

Design of FIR and IIR filters: Design of FIR filters using windows, frequency sampling, Remez algorithm and least mean square error methods; Design of IIR filters using impulse invariance, bilinear transformation and frequency transformations.

Discrete Fourier Transform (DFT): Computational problem, DFT relations, DFT properties, fast Fourier transform (FFT) algorithms (radix-2, decimation-in-time, decimation-in-frequency), Goertzel algorithm, linear convolution using DFT. Multi-dimensional DFT (M-D DFT) and its computation.

Finite word length effects in digital filters: Fixed- and floating-point representation of numbers, quantization noise in signal representations, finite word-length effects in coefficient representation, roundoff noise, SQNR computation and limit cycle.

Introduction to multirate signal processing: Decimation, interpolation, polyphase decomposition, non-integer sample rate conversion, multistage sample rate conversion; Applications of multi-rate filters in signal processing and communication.

Lab Assignments:

Computation platforms: GNU Octave, SciLab, MATLAB.

Hardware platforms: Texas Instruments OMAP-L138/C6748 Development Kit (LCDK) with XDS100V3 Emulator.

Discrete Fourier Transform and Signal representation: n-point DFT and IDFT; Rationalization of Z- function, sketching of Pole-Zero plot and plotting of magnitude and phase response of causal system.

Generation of signals: (i) ramp signals at different sampling frequencies, (iii) multi-toned sinusoid signals, (iv) pseudo random noise sequence; Echo generation using three different delay.

Frequency selective filters: Understanding the concept of Filtering a noisy sinusoid using convolution in Time Domain and Frequency domain; Evaluation of frequency responses of filters using various window techniques.

Design of filters (Butterworth and Chebyshev LP, BP and HP): FIR filters and IIR filters (Bilinear Transformation and Impulse Invariance Method).

Audio Signal Processing: Audio loop, Audio Delay, Audio Echo.

Text:

2. S. K. Mitra," Digital Signal Processing: A Computer- Based Approach", Tata McGraw Hill, 3/e, 2006.

References:

2. Richard G. Lyons, “Understanding Digital Signal Processing”, Prentice Hall, 3/e, 2011.
3. S. Salivahanan, A. Vallavaraj, C. Gnanapriya,” Digital Signal Processing”, Tata McGraw Hill, New Delhi, 2003.
4. J. G. Proakis and D. G. Manolakis,” Digital Signal Processing: Principles, Algorithms and Applications”, Pearson Education, 4/e, 2007.
5. E. Ifeachor and B. Jervis,” Digital Signal Processing”, Pearson, 2/e, 2006.
6. A. V. Oppenheim and R. W. Shafer, “Discrete-Time Signal Processing”, Prentice Hall India, 2/e, 2004.
7. V. K. Ingle and J. G. Proakis, “Digital Signal Processing with MATLAB”, Cengage, 2008.
8. M.H. Hayes, “Schaum's Outline on Digital Signal Processing”, McGraw-Hill, 1999.

EC2132	DIGITAL SIGNAL PROCESSING LAB	0-0-2-1
Syllabus:		

ECxxxx	**MEASUREMENT AND INSTRUMENTATION**	**3-0-0-3**

Syllabus:

Introduction to instrumentation, Static and dynamic characteristics of measurement Systems, Error and uncertainty analysis, standards and calibration, Bridges and potentiometers, measurement of R, L and C. Measurements of voltage, current, power, power factor and energy. A.C & D.C current probes, ohmmeter, loading effect, Transducers classification, Measurement of displacement, velocity, acceleration, strain, force, temperature, pressure, flow, level, conductivity, viscosity and humidity, Signal conditioning; Instrumentation amplifier, isolation amplifier, and other special purpose amplifiers, Time, phase and frequency measurements, Cathode ray oscilloscope, Q meter, DMM, frequency counter, spectrum analyzers, logic probe and logic analyzer; programmable logic controller; Virtual instrumentation, Serial and parallel communication. Shielding and grounding.

Texts:

1. E. O. Deobelin, Measurement Systems: Application and Design, 5th Edition, Tata McGraw-Hill, 2003.
2. A. D. Helfrick and W. D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, 2nd Edition, Phi Learning, 2008.

Reference:

1. B. G. Liptak, Instrument Engineers Handbook: Process Measurement and Analysis, 4th Edition, CRC, 2003.
2. A. K. Sawhney, A course of Electrical and Electronic Measurement and Instrumentation, 9th Edition,

Dhanpat Rai Publication, 2014.

CS2041	OPERATING SYSTEMS	3-0-0-3

Syllabus:

Process Management: process, thread, scheduling; Concurrency: mutual exclusion, synchronization, semaphores, deadlocks; Memory Management: allocation, protection, hardware support, paging, segmentation; Virtual Memory: demand paging, allocation, replacement, swapping, segmentation, TLBs; File Management: naming, file operations and their implementation; File Systems: allocation, free space management, directory management, mounting; I/O Management: device drivers, disk scheduling, Basics of Security.

Texts:

1. Silberschatz, A. and Galvin, P.B. Operating System Concepts, Wileys

References:

1. Stalling, W. Operating Systems: Internals and Design Principles, Pearson
2. Tanenbaum, A. S. Modern Operating System, Pearson
3. Dhamdhere, D.M. Operating Systems A Concept Based Approach, Mc Graw Hill

CS2141	OPERATING SYSTEMS LAB	0-0-2-1

Lab Assignment:

Implementation of CPU scheduling, Shared memory and IPC, Semaphores, file allocation strategies, File Organization Techniques, Dead Lock Avoidance & Detection, page replacement algorithms, Threading & Synchronization

Assignment on fork, shared memory and IPC, scheduling, deadlock, resource allocation graph, page replacement algorithms, disc scheduling

Reference Book:

1. Silberschatz, A. and Galvin, P.B. Operating System Concepts, Wileys.
2. Stalling, W. Operating Systems: Internals and Design Principles, Pearson
3. Tanenbaum, A. S. Modern Operating System, Pearson
4. Richard Stevens, Unix Network Programming, Volume 2, Second Edition: Interprocess Communications, Prentice Hall.

EC304	**CONTROL SYSTEMS**	**3-1-0-4**

Mathematical models of physical systems: differential equations of physical systems, state-space models, transfer functions, block diagram algebra, signal flow graphs. Time-domain techniques: response of second-order systems, characteristic-equation and roots, Routh-Hurwitz criteria, Root-Locus. Frequency-domain techniques: frequency responses, Bode-plots, gain-margin and phase-margin, Nyquist plots. Compensator design: proportional, PI and PID controllers, lead-lag compensator. Modern control system techniques: state-space representations of transfer functions, controllability, observability, pole placement by state feedback, observer and observer-based state feedback control, Linear Quadratic Regulator (LQR).

Text Books: 1. R. C. Dorf and R. H. Bishop, Modern Control Systems, Prentice Hall, 2010.
Reference Books: 1. K. Ogata, Modern Control Engineering, Prentice Hall India, 2010. 2. B. C. Kuo, Automatic Control Systems, Wiley, 2002. 3. I. J. Nagrath and M. Gopal, Control Systems Engineering, New Age Publishers, 2010. 4. G. C. Goodwin, S. F. Graebe, and M. E. Salgado, Control System Design, Prentice Hall, 2000

SEMESTER-V

Sem.	Course Code	Course Name	L	T	P	C
V	EC3044	Digital Communication	3	0	0	3
V	EC3144	Digital Communication Lab	0	0	2	1
V	EC3051	Analog Integrated Circuits	3	0	0	3
V	EC3151	Analog Integrated Circuits Lab	0	0	2	1
V	EC3072	Embedded Systems	3	0	0	3
V	EC3172	Embedded Systems Lab	0	0	2	1
V	EC3046	Communication Network	3	1	0	4
V	PEXXX	Professional Elective – 1	3	0	0	3
V	OEXXX	Open Elective - 1	3	0	0	3
		Total	18	1	6	22
		Contact Hours / Week	25			

Humanities & Social Science (HS)	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total
0	0	0	16	3	3	0	0	22

5th Semester	**EC3044: DIGITAL COMMUNICATION**	**Core**
Objectives:	• To introduce students to the fundamental concepts and principles of digital communication systems, including signal processing, modulation, demodulation, channel coding, and error correction. • To study advanced digital modulation schemes used in modern communication systems, such as quadrature amplitude modulation (QAM), phase-shift keying (PSK), and frequency-shift keying (FSK). • Multiple Access Techniques: To understand how multiple users can efficiently share the same communication channel, including techniques like Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA), Code Division Multiple Access (CDMA), and Orthogonal Frequency Division Multiple Access (OFDMA).	

Prerequisites:	Principles of Communication and Signal and Systems	
Module	Syllabus	No. of Lectures
I	Review of Digital Representation of Analog Signals: Sampling, Quantization, Pulse amplitude modulation (PAM); Elements of a Digital communication System, Transmission Pulse Shaping, Power Spectral Density, Additive White Gaussian Noise (AWGN) Channel; Optimal Receiver Design, Signal-to-Noise Power Ratio (SNR), Matched Filtering (MF); Maximum Likelihood (ML) Receiver;	10
II	Geometric representation of signal waveforms: Vector space concepts, Signal space concepts, Orthogonal expansions of signals, Gram-Schmidt orthogonalization procedure; Digital Modulation Techniques; Binary Phase Shift Keying, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Quadrature Amplitude Modulation (QAM), M-ary Phase Shift Keying (MPSK) and associated Probability of Error;	12
III	Digital Communication through band-limited AWGN channel: Inter-symbol interference (ISI), Eye-diagram; signal design for band-limited channel for zero ISI – Nyquist criterion, raised-cosine and square-root raised cosine signals for transmit and receive pulse shaping; Partial-response signaling; Passband-Baseband Equivalence.	13
IV	Phase-coherent demodulation, Non-coherent demodulation; Continuous-phase FSK (CPFSK), Minimum-shift keying; Continuous-phase modulation (CPM); Differential modulation schemes; Multiple Access Techniques: Time Division Multiple Access (TDMA); Frequency Division Multiple Access (FDMA); Code Division Multiple Access (CDMA);	9
Text:	1. J. G. Proakis and M. Salehi, "Fundamentals of Communication Systems", Pearson Education, 2005. 2. S.Haykin, "Communication Systems", Wiley- Student Edition, 5/e, 2010.	
References:	1. B. Sklar, "Digital Communication: Fundamentals and Applications", Pearson India, 2/e, 2009. 2. Clover, "Digital Communication", Pearson India, 2/e, 2007. 3. J.B. Anderson, "Digital Transmission Engineering", IEEE Press, Wiley-Interscience,2/e, 2005. 4. S.Haykin, "Digital Communication Systems", Wiley Student Edition, 2014.	

5th Semester	**EC3144: DIGITAL COMMUNICATION LAB**	**Core**
Objectives:	To provide students with hands-on practical experience in designing, implementing, and analyzing digital communication systems. The lab complements the theoretical knowledge gained in the digital communication theory course and helps students develop essential skills related to digital modulation, demodulation, and transmission.	
Prerequisites:	Principles of Communication and Communication Lab	

Syllabus	No. of Lab Class
Pulse Code Modulation and Demodulation Techniques; Signal Sampling and Reconstruction Techniques; Delta Modulation and Adaptive Delta Modulation; Time Division Multiplexing and Demultiplexing; Pulse shaping; Nyquist criterion; Amplitude Shift Keying Modulation and Demodulation; Binary Phase Shift Keying Modulation and Demodulation; Quadrature Phase Shift Keying Modulation and Demodulation; Frequency Shift Keying Modulation and Demodulation; Quadrature Amplitude Modulation and Demodulation Techniques; Differential modulation schemes.	10

References:	1. J. G Proakis and M. Salehi, "Modern Communication Systems Using MATLAB", CENGAGE INDIA, 3rd Edition 2013.

EC3051	**ANALOG INTEGRATED CIRCUIT**	**3-0-0-3**

Syllabus:

Introduction to analog VLSI and mixed signal issues in CMOS technologies, Basic MOS models, SPICE Models and frequency dependent parameters, Basic NMOS/CMOS gain stage, MOS amplifiers (CS-CG-CD), and MOS differential amplifier and OPAMP design, feedback, different feedback configurations. Two stage MOS operational amplifier, cascade and cascode circuits, MOS telescopic cascade amplifier, folded cascade amplifier, frequency response, stability and noise issues in amplifiers. Different output stages and their characterization. CMOS analog blocks: Current Sources and Voltage references. Low current, supply insensitive and temperature insensitive biasing. Frequency Synthesizers and Phased lock-loops, Lock range limitations. Non-linear analog circuits: precision rectification, comparators, charge-pump circuits and multipliers, basics of data converters, analog testing and layout issues, low voltage and low power circuits, logarithmic amplifiers – log and antilog amplifiers.

Texts:

1. Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw hill Education. 2008

Reference:

1. Adel S Sedra, Kenneth C Smith, Microelectronics Circuits, Theory and Applications, Oxford International Students Edition.
2. P. Gray, P. Hurst, S. Lewis and R. Meyer, Analysis & Design of Analog Integrated Circuits, 5/e, Wiley.
3. R. Jacob Baker, CMOS: Circuit Design, Layout, and Simulation, Revised Second Edition, 2008, Wiley-IEEE
4. P. E. Allen and D. R. Holberg, *CMOS Analog Circuit Design*, 2nd Edition, Oxford University Press
5. *"Analog Design Essentials" by Willy M. C. Sansen,*
6. D. A. Johns and K. Martin, *Analog Integrated Circuit Design*, Wiley Student Edition, 2002.

EC3151	**ANALOG INTEGRATED CIRCUIT LAB**	**0-0-2-1**

Syllabus:

Experiments are based on the following topics: Introduction CAD tools and analog design flow, NMOS and PMOS characteristics, Common source amplifiers, layout of resistors, capacitors, transistors, differential amplifier, cascode amplifier, current mirror, push pull CS amplifier, negative feedback amplifier, multistage amplifiers, operational

amplifiers and comparators.

Texts:

1. *B. Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill, 2001.*

Reference:

1. *M. H. Rashid, Introduction to PSpice Using or CAD for Circuits and Electronics, 3rd Edition, Prentice-Hall India, 2006.*
2. *"CMOS Analog Circuit Design" by Phillip Allen and Douglas R. Holberg.*
3. *"Analog Design Essentials" by Willy M. C. Sansen,*
4. P. R. Gray and R. G. Meyer, *Analysis and Design of Analog Integrated* Circuits, 4th Edition, Wiley Student Edition, 2001.
5. D. A. Johns and K. Martin, *Analog Integrated Circuit Design*, Wiley Student Edition, 2002.

EC3072	**EMBEDDED SYSTEMS**	**3-0-0-3**

Introduction: Introduction to embedded systems with examples, characteristics of embedding computing applications, concept of real-time system, challenges in embedded system design. Design process: requirements, specifications, architecture design, designing of components, system integration. Instruction set architecture: cisc and risc instruction set architecture. Embedded system architecture: basic embedded processor/microcontroller architecture, cisc examples, 8051, risc example, arm architecture, dsp processors, harvard architecture, pic. Memory system architecture: caches, virtual memory, memory management unit and address translation. Designing embedded computing platform: the cpu bus, memory devices, i/o devices, component interfacing, design with microprocessor. Processes and operating systems: multiple tasks and multiple processes; pre-emptive real-time operating systems, priority- based scheduling, inter process communication mechanisms, evaluating operating system performance, power management and optimization for processes. Networks: distributed embedded architectures; networks for embedded systems. Case studies: washing machine, inkjet printer, telephone exchange, etc.

Text Books:

1. W. Wolf, "Computers as components: Principles of embedded computing system design", 2/e, Elsevier, 2008.

Reference Books:

1. D. Symes, and C. Wright, "ARM system developer's guide: Designing and optimizing system software", Elsevier,2008.
2. Muhammad Ali Mazidi, Janice G. Mazidi, Rolin D. McKinlay, "Jack Ganssle, The 8051 Microcontroller and Embedded Systems ".
3. Jack Ganssle, "The art of designing embedded systems", 2/e, Elsevier, 2008.

EC3172	EMBEDDED SYSTEMS LAB	0-0-2-1
Familiarization with ARM microcontroller development environment, assembler, compiler, simulator, debugger and JTAG; Interfacing: LED Blinking, seven segment display, ADC and DAC interfacing, LCD interfacing, Applications: LCD desk clock, pressure and temperature monitoring, different controller implementation in ARM (P, PI, PID etc.), speed control of DC motor, speed and direction control of stepper motor; project.		

5th Semester	**EC3046: COMMUNICATION NETWORK**	**Core 3-1-0-4**
Objectives:	To provide students with a comprehensive understanding of the principles, technologies, protocols, and practices related to communication networks.	
Prerequisites:	Digital Communication and Signal and Systems	
Module	Syllabus	No. of Lectures
I	Introduction to Communication Networks: Overview of communication networks; Types of networks: LAN, WAN, MAN, PAN, etc., Network topologies and architectures; Basics of Data Communications for networking; Circuit Switching, Packet switching, Software-defined networking (SDN); Network Function Virtualization (NFV); Digital Switching: Space switching, Multistage switching, Time multiplexed space and time switching, time and space switches;	12
II	Fundamentals of Queueing Theory: Introduction to Queuing Theory; Arrival and Service Process; Poisson Process; Memory lessness; Little's Theorem; Discrete Time Markov Chain (DTMC); Continuous Time Markov Chain (CTMC); Simple queueing models: M/M/1 Queue; M/M/m and M/M/m/m System;	12
III	Network Protocols and Layers: OSI model and TCP/IP model; Functions and responsibilities of each network layer; Data Link Layer: Error detection and correction; MAC protocols (CSMA/CD, CSMA/CA, etc.), Ethernet, Wi-Fi, and other data link technologies; Network Layer: IP addressing and subnetting; Routing algorithms and protocols (e.g., RIP, OSPF, BGP); IPv4 and IPv6;	10
IV	Transport Layer: Transport layer services (connection-oriented vs. connectionless); TCP and UDP protocols; Flow control and congestion control; Application Layer: Common application layer protocols (HTTP, DNS, SMTP, FTP, etc.);	9
Text:	1. A. Leon-Garcia and I. Widjaja: Communication Networks; 2/e, McGraw Hill, 2004. 2. J.F. Kurose and K. W. Ross: Computer Networking, A Top-Down Approach, 4/e, Pearson/Addison Wesley,2008.	
References:	1. D. Bertsekas and R. Gallagar, Data Networks, 2/e, PHI, 1992. 2. A. S. Tanenbaum, Computer Networks, 3/e, PHI, 1997. 3. W. Stallings, Data and Computer Communication, 7/e, Prentice-Hall, 2004.	

SEMESTER-VI

Sem.	Course Code	Course Name	L	T	P	C
VI	EC3052	VLSI Design	3	0	0	3
VI	EC3152	VLSI Design Lab	0	0	2	1
VI	EC3061	Microwave Engineering	3	0	0	3
VI	EC3161	Microwave Engineering Lab	0	0	2	1
VI	EC4047	Mobile Communication	3	0	0	3
VI	PEXXX	Professional Elective – 2	3	0	0	3
VI	PEXXX	Professional Elective – 3	3	0	0	3
VI	OEXXX	Open Elective – 2	3	0	0	3
VI	ECXXX	Minor Project	0	0	4	2
		Total	18	0	8	22
		Contact Hours / Week	26			

Humanities & Social Science (HS)	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total
0	0	0	11	6	3	2	0	22

EC3052	**VLSI DESIGN**	**3-0-0-3**

Syllabus:

Overview of VLSI design methodology, overview of VLSI design flow, fabrication process flow, layout design rules, full custom mask layout design, MOSFET scaling and small geometry effects. Brief ideas of MOS modelling. MOS inverters as VLSI design building blocks. Inverter static characteristics and dynamic characteristics; switching and interconnect issues. Combinational and sequential MOS logic circuits. Dynamic logic circuits using MOS. Construction and characterization of semiconductor memories.

Text:

1. Jan M. Rabaey, Anantha ChandraKasan, Borivoje Nikolic, Digital Integrated Circuits, A Design Perspective, Prentice Hall, second edition, 2003.

Reference:

1. David Hodges, Analysis and Design of Digital Integrated Circuits, In Deep Submicron Technology (special Indian edition)

EC3152	**VLSI DESIGN LAB**	**0-0-2-1**

Familiarization with analog and digital CAD tools. Implementation of MOS inverter circuits using CAD tools and verification of different characteristics of an inverter. Implementation MOS current mirrors and current sources. Implementation of NAND and NOR gates using CMOS logic and observation of their static and dynamic behaviors. Design of flip-flop circuits and study of its transient behavior. Mask layout of an inverter, application of design verification rules, RC extraction, pre and post layout comparison of characteristics.

EC3061	**MICROWAVE ENGINEERING**	**3-0-0-3**

Transmission lines and waveguides: Telegrapher's equations, Lossless and lossy lines, characteristic impedance, voltage, and current relationships, standing waves, impedance matching, Smith chart, TEM, TE and TM Waves, Coaxial cable, Rectangular, and circular waveguides; Narrowband and broadband impedance matching: L-section impedance matching, stub matching, Quarter wave transformer, Theory of small reflections, Multi-section matching transformer, Tapered lines; Microwave networks: Impedance, admittance, transmission and S-parameter analysis of microwave components, Reciprocal and lossless networks, Network matrices transformations, Equivalent circuit extraction. Microwave passive circuits: RLC, microstrip, and waveguide cavity resonators, Hybrid junctions, directional couplers, and power dividers; Microwave tubes: Limitations of conventional tubes, Klystron amplifier, Reflex klystron oscillator, Magnetrons, traveling wave tubes, Microwave solid-state devices: Characteristics of microwave bipolar transistors and FET, transferred electron devices, avalanche diode oscillators.

Text Books:

1. R. E. Collin, Foundations for Microwave Engineering; 2/e, Wiley-IEEE Press, 2000.
2. D. M. Pozar, Microwave Engineering; 3/e, John Wiley & Sons Inc, 2004.

Reference Books:

1. A. Das and S. K. Das, Microwave Engineering; 1/e, Tata McGraw-Hill, 2005.
2. G. Kumar and K. P. Ray, Broadband Microstrip Antennas; 1/e, Artech House, 2002.
3. R. C. Booton, Computational methods for Electromagnetics and Microwaves; 1/e, Wiley, 1992.
4. G. Gonzalez, Microwave Transistor Amplifiers: Analysis and Design; 2/e, Prentice Hall of India, 2007.
5. S. M. Liao, Microwave devices and Circuits;3/e, Prentice Hall of India, 2004.
6. P. A. Rizzi, Microwave Engineering Passive Circuits; 1/e, Pearson, 1998.

EC3161	**MICROWAVE ENGINEERING LAB**	**0-0-2-1**

Familiarization With The Laboratory Equipment; Frequency and wavelength measurements using Klystron amplifier; Determination of voltage standing wave ratio and reflection coefficient; Study of characteristics of Klystron tube and Gunn diodes; Study of S-parameters:- Measurement of the unknown impedance; simulation and measurement of antenna parameters, such as gain, E-plane, and H-plane patterns.

Text Books:

1. D. M. Pozar, Microwave Engineering; 3/e, John Wiley & Sons Inc, 2004.

Reference Books:

1. S. M. Liao, Microwave devices and Circuits;3/e, Prentice Hall of India, 2004.

6th Semester	**EC4047: MOBILE COMMUNICATION**	**Core 3-0-0-3**
Objectives:	To provide students with a comprehensive understanding of mobile communication systems and technologies.	
Prerequisites:	Digital Communication and Signal and Systems	
Module	Syllabus	No. of Lectures
I	Evolution of mobile radio communication; Different generations of wireless communication and their technical specifications; Overview of current wireless systems and standards; The Cellular Concept: Cellular concept, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference & system capacity, Trunking & grade of service, Improving coverage and capacity in cellular system.	10
II	Introduction to Mobile Radio Propagation, Free space propagation model, three basic propagation mechanism (Reflection, diffraction and scattering), Two ray ground reflection model, Large Scale Path Loss: Link budget design using path loss models, Outdoor and indoor propagation models.	11
III	Small scale multipath propagation, Parameters of mobile multipath channels, Types of small-scale fading; Fading effects due to multipath time delay spread, fading effects due to Doppler spread and doppler spread; Rayleigh fading and Ricean fading.	10
IV	Mitigation of fading effects: Channel Equalization; Linear and Non-linear equalizer; Adaptive equalizer, Algorithms for adaptive equalization; Diversity techniques; Types of diversity; Diversity combining techniques: Maximal Ratio Combining Diversity, Equal Gain Combining Diversity, Selection diversity; RAKE receiver.	11
Text:	1. T. S. Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Pearson Education, 2004. 2. S. Haykin and M. Moher, Modern Wireless Communications, 1st Edition, Pearson Education, 2005.	
References:	1. A. J. Goldsmith, Wireless Communications, Cambridge University Press, 2005 2. G. L. Stuber, Principles of Mobile Communications, Kluwer, 1996. 3. D. Tse and P. Viswanath, Fundamentals of Wireless Communications, Cambridge University Press, 2005.	

SEMESTER-VII

Sem.	Course Code	Course Name	L	T	P	C
VII	PEXXX	Professional Elective - 4	3	0	0	3
VII	PEXXX	Professional Elective - 5	3	0	0	3
VII	HSXXX	HSS Elective - 2	3	0	0	3
VII	OEXXX	Open Elective - 3	3	0	0	3
VII	ECXXX	Summer Internship	0	0	4	2
VII	ECXXX	Project – I	0	0	12	6
		Total	12		16	20
		Contact Hours / Week	28			

Humanities & Social Science (HS)	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total
3	0	0	0	6	3	8	0	20

ECxxx **INTERNSHIP** **0-0-3-3**

Guidelines for Internship

Employers are increasingly prioritizing experience when picking students from academic institutions. Keeping this in view, students are encouraged to attend summer internship after 4th and 6th Semester. They are also encouraged to attend training or skill development program after 2nd semester. However, the training or skill development programs will not be considered as internship. A maximum of three credits will be awarded at the end of the internship (that is in 7th semester). Students are encouraged to read the following points in the context of internship.

Organization: Students are encouraged to opt a reputed IT/Electronics related industry or academic/ research institutions for their internship. The term reputed IT/Electronics related industry refers to an organization, who have recently introduced a disruptive sustainable business model. It may be start-ups or an established company. In case of the start-ups, the company must have a valid registration number according to the Company ACT (Country of origin). The term reputed academic/ research institutions refers to an academic or research organization either recognized as Institute of National Importance or organizations with NIRF ranking less than 100 if the organization is located in India. If the organization is located outside of India the times higher education ranking shall be less than 800. Internship in general should be outside the IIIT Senapati, Manipur only. In case of students are interested to do specific research work with any faculty member of IIIT Senapati, Manipur, they are encouraged to do so only during the semester as mini project but not in the summer vacation.

Duration: During the entire B.Tech. Program attending a minimum of 8 weeks of internship is mandatory. They might attend multiple internships in multiple organizations or one internship of at-least 8 weeks long in one

organization. However, the minimum duration of each internship will be 4 weeks (in one organization), if students are opting for multiple internships. They must finish the 8-weeks internship program before enrolling in 7th semester. Students normally have two summer vacations of approximately two months each to complete the internship and one summer vaccination to complete the training and skill development program of their own. Mode of internship: No restrictions are there regarding the mode of the internship. It may be online or offline. However, the preferred mode of internship is offline.

Assistance: The single point of contact for Internship is: Faculty-in-Charge, Training and Placement Cell, IIIT Manipur, training@iiitmanipur.ac.in. Students may also contact the mentor faculty for any other assistance related to the internship.

Documents required to apply: Academic section of the institute will provide the certificates (if required, including No-objection-Certificate, Bonafide Certificate) to apply for the internship. However, students may approach any faculty member of their choice for the letter of recommendation (if required).

Report: At the end of the internship, students need to submit an internship report (Hardcopy, 40-60 Page long, template may download from http://iiitmanipur.ac.in/pages/essentialInfo.php) duly signed by the supervisor/ mentor appointed by the industry to the Head of Department along with the internship offer-letter. In case of multiple internships, they need to submit multiple reports and multiple offer letters. The internship report must include a certificate from the supervisor/ mentor stating that the work done during the internship is genuine and is not copied from any other sources. The name of the supervisor/ mentor, designation, name of the organization, email ID and phone-number should be vivid on the certificate. Each department will form a committee to evaluate the internship reports the first week of the seventh semester.

Evaluation: Students need to present the work done during internship(s) in the first week of beginning of the seventh semester in-front of a committee formed by the department; the committee will also evaluate the internship reports and will award grades.

SEMESTER-VIII

Sem.	Course Code	Course Name	L	T	P	C
VIII	ECXXX	Project/Internship – II	0	1	22	12
		Total	0	1	22	12
		Contact Hours / Week	24			

Humanities & Social Science (HS)	Basic Science (BS)	Engineering Sciences (ES)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Internship / Project	Mandatory	Total
0	0	0	0	0	0	12	0	12

ELECTIVES

Professional Elective (PE)	Semester	Course Title	Hours per week			Credits
			L	T	P	
Professional Elective - 1	5th	HDL based Digital System Design	3	0	0	3
			3	0	0	3
			3	0	0	3
Professional Elective - 2	6th	Information Theory and Coding	3	0	0	3
		Communication Systems	3	0	0	3
			3	0	0	3
Professional Elective - 3	6th	Antenna and Wave Propagation	3	0	0	3
		Microwave system Design	3	0	0	3
		Wireless Sensor Network	3	0	0	3
Professional Elective - 4	7th	Advances in Wireless Communication Technologies	3	0	0	3
		VLSI Technologies	3	0	0	3
		Modern Error correcting codes	3	0	0	3
Professional Elective - 5	7th	Statistical Signal Processing	3	0	0	3
		Biomedical Signal Processing	3	0	0	3
		Adaptive Signal Processing	3	0	0	3

PEXXX	**HDL BASED DIGITAL SYSTEM DESIGN**	**3-0-0-6**

Syllabus:

Introduction to digital circuit design flow, Verilog variables, operators and language constructs, modeling combinational circuits using Verilog, modeling sequential circuits using Verilog, Verilog test benches and design simulation, Behavioral versus structural design modeling, Miscellaneous modeling issues: pipelining, memory, etc., Processor design using Verilog.

Texts:

1. Contemporary logic Design, R.H. Katz, Prentice Hall, 2nd Edition, 2004.
2. Fundamentals of Digital Logic with Verilog Design, Stephen Brown, Zvonko Vranesic, 3rd Edition, McGraw-Hill, 2013.

References:

1. Verilog HDL Synthesis A Practical Primer, J. Bhasker, BS Publications, 1st Edition, 1998.

2. Verilog HDL: a guide to digital design and synthesis, Samir Palnitkar, Pearson, 2nd Edition, 2019.

	PEXXXX: INFORMATION THEORY AND CODING	**Core**
Objectives:	To provide students with a comprehensive understanding of fundamental concepts and techniques related to information theory and coding. By the end of the course, students should be able to: • Understand basic concepts of information, entropy, and uncertainty. • Comprehend source coding techniques. • Understand channel coding and error correction methods.	
Prerequisites:	NIL	
Module	Syllabus	No. of Lectures
I	Introduction to Information Theory: History and background of Information Theory; Basic concepts: Uncertainty; self-information; Entropy; Discrete memoryless source; Joint Entropy; Conditional Entropy; mutual information and their properties; Information measures of continuous random variables; Differential Entropy;	9
II	Channel Models and Capacity; Importance and types of various channel models; Channel capacity calculation; Binary symmetric channel, binary erasure channel; Gaussian channel; Shannon's channel capacity and channel coding theorem; Shannon's limit. Source coding; Average code length; Kraft's inequality; Optimal code length; Shannon Fano Elias coding; Huffman coding; Non binary Huffman codes;	13
III	Introduction to Error control codes; Block codes, linear block codes, generator and parity check matrices, standard Array and syndrome Decoding; cyclic codes and their properties, Encoder and Decoder design; serial and parallel concatenated block code;	11
IV	Convolution Codes; Properties, Encoder-Tree diagram, Trellis diagram, state diagram, transfer function of convolutional codes, Viterbi Decoding, Trellis coding, Reed Solomon codes.	9
Text:	1. T. M. Cover and J. A. Thomas, Elements of Information Theory, 1/e, John Wiley, 1991. 2. S. Lin and D.J. Costello, Error Control Coding, 2/e, Prentice-Hall, 2004.	
References:	1. R. B. Ash, Information Theory, 1/e, Dover Publisher, 1990. 2. Todd K. Moon, Error Control Coding: Mathematical Methods and Algorithms, 1/e, Wiley, 2005.	

EC47X	**PEXXXX: COMMUNICATION SYSTEMS**	**3-0-0-3**

Syllabus:

Optical Communication:

Basic Introduction: Ray theory transmission- Total internal reflection-Acceptance angle – Numerical aperture – Skew rays Components: Optical Transmitter, Optical amplifier, Photoreceiver, Transmission media - free-space, twisted pair and coaxial cable, Optical Fiber.

Transmission System: Baseband and modulated transmission, bandwidth filtering, demodulation and signal recovery, multimode and single-mode; attenuation and dispersion; Optical MUX and DEMUX - Operating principle of multiplexers and de-multiplexors, optical telecoms

Satellite Communication:

Basic Principles: General features, frequency allocation for satellite services, properties of satellite communication systems. Satellite Orbits: Introduction, Kepler's laws, orbital dynamics, orbital characteristics, satellite spacing and orbital capacity, angle of elevation, eclipses, launching and positioning, satellite drift and station keeping. Satellite Links: Introduction, general link design equation, system noise temperature, uplink design, downlink design, complete link design, effects of rain. Earth Station: Introduction, earth station subsystem, different types of earth stations. The Role and Application of Satellite Communication.

Texts:

1. John M. Senior, Optical Fiber Communication, 3rd Edition, Pearson Education, 2009
2. Gerd Keiser, Optical Fiber Communication, 3rd Edition, Mc Graw Hill, 2000
3. Timothy Pratt, Charles W. Bostian, Satellite Communications, 2nd Edition, John Wiley & Sons, 2003.

References:

1. J.Gower, Optical Communication System, 2nd Edition, Prentice Hall of India, 1993.
2. Rajiv Ramaswami, Kumar N Sivarajan, Galen H. Sasaki, Optical Networks, 3rd Edition, Morgan Kufmann, 2010.
3. Govind P. Agrawal, Fiber-optic communication systems, 3rd edition, John Wiley & sons, 2002.
4. R.P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2004
5. Dennis Roddy, Satellite Communications, 3rd Edition, Mc. Graw-Hill International Ed. 2001

EC47X	**PEXXXX: ANTENNA AND WAVE PROPAGATION**	*3-0-0-3*

Syllabus:

Introduction to antenna, Radiation Fundaments, wave equation for potential functions, Solution of potential equations using Green's function, Antenna Field Regions: Near and Far-field Regions, Isotropic, Omnidirectional Wire antennas: Dipole, Radiation Equations, Image theory, Monopole, Loop; Aperture antennas: Field Equivalence

Principle, Equivalent models for magnetic source radiation, Uniqueness Theorem, Slot, Open-ended waveguide, Horn, Reflector antennas, Wave Polarization: Linear, Circular and Elliptical polarizations Antenna arrays: Linear array and Pattern Multiplication, two-element array, N Element uniform Linear array, Broadside Array, End fire Array, Array with non-uniform excitation; Yagi – Uda array, Log-periodic dipole array, Long wire, V, Rhombic Antennas, Turnstile antenna, Helical, Biconical, Spiral, Microstrip antennas, Antenna Measurements: Radiation pattern, E-Plane and H-plane patterns, Radiation resistance, Radiation Intensity, Directivity, Gain, Plane Waves, input impedance, return loss and reflection coefficient, Radio Wave Propagation: Ground wave, Ionospheric propagation.

Texts:

1. A.R. Harish, M. Sachidananda, Antennas and Wave Propagation, 1st Edition, Oxford, 2007.

References:

1. C. A. Balanis, Antenna Theory: Analysis and Design, 3rd Edition John Wiley, 2005.
2. J. D. Kraus, R. J. Marhefka, A. S Khan, Antennas and Wave Propagation, 4th Edition, Tata McGraw-Hill, 2011

EC47X	**MICROWAVE SYSTEM DESIGN**	**3-0-0-3**

Syllabus:

Transmission Line: Fundamental of transmission line, Different types of planar transmission lines; Discontinuities and components; Passive circuit design: Filter design, Power divider, 90˚ and 180˚ hybrid couplers and multi-section couplers; Noise and Non-linear distortions: Noise Figure, Non-linear distortion, Dynamic Range; Active circuit design: Amplifier, Mixer, Oscillator and Switches; Microwave Antennas, Microwave measurement techniques.

Texts:

1. D. M. Pozar, “Microwave Engineering,” 4th Edition, Wiley, 2013.
2. G. Gonzalez, “Microwave Transistor Amplifiers: Analysis and Design,” 2nd Edition, Prentice Hall, 1996.
3. R. J. Marhefka, A. S. Khan and J. D. Kraus, “Antennas and Wave Propagation”, Tata McGraw - Hill Education 2010.

References:

1. D. M. Pozar, “Microwave and RF Design of Wireless Systems,” John Wiley & Sons, 2001.
2. Balanis, C.A., “Antenna Theory and Design”, 3rd Edition, John Wiley & Sons, 2005.1

Xxxx Semester	**PEXXXX: WIRELESS SENSOR NETWORK**	**Elective**
Objectives:	To provide students with a comprehensive understanding of the principles, theory, and applications of advanced error correcting codes used in various communication and storage systems. The course aims to equip students with the necessary knowledge and skills to design,	

	analyze, and implement modern error correcting codes for reliable data transmission and storage.	
Prerequisites:	Communication Network and Mobile Communication	
Module	Syllabus	No. of Lectures
I	Sensor Network Concept: Introduction, Networked wireless sensor devices, Advantages of Sensor networks, Applications, Key design challenges. Network deployment: Structured versus randomized deployment, Network topology, Connectivity, Connectivity using power control, Coverage metrics, Mobile deployment.	8
II	Localization and Tracking: Issues and approaches, Problem formulations: Sensing model, collaborative localization. Coarse-grained and Fine-grained node localization. Tracking multiple objects.	13
III	Wireless Communications: Link quality, shadowing and fading effects Medium-access and sleep scheduling: Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques, and Contention-free protocols.	11
IV	Routing: Metric-based approaches, Multi-path routing, Lifetime-maximizing energy-aware routing techniques, Geographic routing. Sensor network Databases: Data-centric routing, Data-gathering with compression.	10
Text:	1. Wireless Sensor Networks: An Information Processing Approach- by Feng Zhao, Leonidas Guibas , Morgan Kaufmann Series in Networking 2004.Coding: Mathematical Methods and Algorithms, 1/e, Wiley, 2005.	
References:	1. Networking Wireless Sensors: Bhaskar Krismachari, Cambridge University Press. 2. Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam, TaiebZnati, Springer. 3. Wireless Sensor Networks: Technology, Protocols, and Applications: Kazem Sohraby, Daniel Minoli, Taieb Znati, Wiley Inter Science.	

Xxxx Semester	**PEXXXX: MODERN ERROR CORRECTING CODES**	**Elective**
Objectives:	To provide students with a comprehensive understanding of the principles, theory, and applications of advanced error correcting codes used in various communication and storage systems. The course aims to equip students with the necessary knowledge and skills to design, analyze, and implement modern error correcting codes for reliable data transmission and storage.	
Prerequisites:	Digital Communication and Information Theory and Coding	
Module	Syllabus	No. of Lectures
I	Introduction: linear block codes - generator and parity-check matrices, minimum distance, syndrome; convolutional codes - encoding, trellis, Viterbi decoding algorithm.	8
II	Low-density parity-check (LDPC) codes: graphical representations in terms of Tanner graphs, degree distributions, regular and irregular ensembles; decoding of LDPC	13

	codes by message-passing principle; density evolution and extrinsic information transfer (EXIT) chart, computation of decoding threshold, optimization of degree distributions; encoding of LDPC codes; important classes of LDPC codes- protograph LDPC codes and spatial coupling, quasi-cyclic LDPC codes, accumulator-based LDPC codes.	
III	Polar codes: channel polarization, recursive channel transformations, transformation of rate and reliability; code construction; encoding; successive cancellation decoding; performance of polar coding; list decoding of polar codes; Reed-Muller code and its relationship to polar codes.	11
IV	Trellis coded modulation (TCM): preliminaries on signal constellations; construction of TCM codes, decoding of TCM codes, performance analysis, rotational invariance, multidimensional TCM and its advantages.	10
Text:	1. W. E. Ryan and S. Lin, Channel Codes: Classical and Modern, 1/e, Cambridge University Press, 2009. 2. Todd K. Moon, Error Control Coding: Mathematical Methods and Algorithms, 1/e, Wiley, 2005.	
References:	1. S. Lin and D.J. Costello, Error Control Coding, 2/e, Prentice-Hall, 2004.	

Xxxxx Semester	**PEXXXX: STATISTICAL SIGNAL PROCESSING**	**Elective**
Objectives:	To provide students with a comprehensive understanding of the theoretical foundations and practical applications of statistical methods in processing and analyzing signals.	
Prerequisites:	Signal and Systems and Probability and Random Process	
Module	Syllabus	No. of Lectures
I	Introduction; Stationary processes: Strict sense and wide sense stationarity; Correlation and spectral analysis of discrete-time wide sense stationary processes, white noise, response of linear systems to wide-sense stationary inputs, spectral factorization;	9
II	Parameter estimation: Properties of estimators, Minimum Variance Unbiased Estimator (MVUE Cramer Rao bound, MVUE through Sufficient Statistics, Maximum likelihood estimation- properties. Bayesian estimation-Minimum Mean-square error (MMSE) and Maximum a Posteriori (MAP) estimation. Signal estimation in white Gaussian noise– MMSE, conditional expectation; Linear minimum mean-square error (LMMSE) estimation, orthogonality principle and Wiener Hoff equation;	13
III	FIR Wiener filter, linear prediction-forward and backward predictions, Levinson-Durbin Algorithm, application –linear prediction of speech, Non-causal IIR wiener filter, Causal IIR Wiener filtering Iterative and adaptive implementation of FIR Wiener filter: Steepest descent algorithm, LMS adaptive filters, convergence analysis, least-squares (LS) method, Recursive LS (RLS) adaptive filter, complexity analysis, application- neural network;	13
IV	Kalman filters: Gauss-Markov state variable models; innovation and Kalman	8

	recursion, steady-state behaviour of Kalman filters.	
Text:	1. S. M. Kay, Fundamentals of Statistical Signal Processing: Detection Theory, 1st edition, Prentice Hall PTR, 1998. 2. S. M. Kay, Fundamentals of Statistical Signal Processing: Estimation Theory, 1st edition, Prentice Hall PTR, 1993.	
References:	1. H. V. Poor, An Introduction to Signal Detection and Estimation, 2nd edition, Springer, 1994. 2. H. L. Van Trees, Detection, Estimation and Modulation Theory, Part I, 1st edition, John Wiley, 1968. 3. D. L. Melsa and J. L. Cohn, Detection and Estimation Theory, 1st edition, McGraw Hill, 1978.	

ECXXXX	**PEXXXX: ADAPTIVE SIGNAL PROCESSING**	**3-0-0-6**

Syllabus:

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices. Optimal FIR (Wiener) filter, Method of steepest descent, extension to complex valued The LMS algorithm (real, complex), convergence analysis, weight error correlation matrix, excess mean square error and mis-adjustment.

Variants of the LMS algorithm: the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering. Signal space concepts - introduction to finite dimensional vector space theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, Gram-Schmidt orthogonalization, concepts of orthogonal projection, orthogonal decomposition of vector spaces.

Vector space of random variables, correlation as inner product, forward and backward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

Introduction to recursive least squares (RLS), vector space formulation of RLS estimation, pseudo inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: Affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

Texts:

1. S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
2. C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

References:

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

Open Elective (OE)	Semester	Course Title	Hours per week			Credits
Open Elective - 1	5th	Computer Organization and Architecture	3	0	0	3
		Computer Graphics	3	0	0	3
			3	0	0	3
Open Elective - 2	6th	Internet of Things	3	0	0	3
		Artificial Intelligence	3	0	0	3
		Optimization Engineering	3	0	0	3
Open Elective - 3	7th	Image and Video Processing	3	0	0	3
		Audio and Speech Processing	3	0	0	3
		Natural Language Processing	3	0	0	3

CSXXXXX	COMPUTER ORGANIZATION AND ARCHITECTURE	3-0-0-3

Syllabus:

Review: History of computer architecture, combinational vs sequential logic, integer arithmetic: carry look-ahead, booths algorithm, division (restoring and non-restoring) [Covered in EC101], Hardware description languages, physical constraints (gate delay, fan-in, fan-out, energy/power). microcontrollers.

Instruction Set Architecture: Introduction to instruction set architecture, Basic organization of computing machine: fetch, decode, and execute; Instruction set types, instruction format, addressing modes, subroutine call and return mechanisms; Structure of machine-level programs; Low-level architectural support for high level languages. Performance assessment; ARM Instruction Set and Intel X86 instruction set.

Computer Arithmetic: Representation of numeric data, signed and unsigned arithmetic; floating-point arithmetic representation, arithmetic: addition, subtraction, multiplication, division; design of arithmetic and logic unit.

Processor Architecture: CISC vs RISC Designs, simple implementation schemes, data path design, control unit: hardwired realization vs micro-programmed realization, multi-cycle implementation. Instruction level parallelism, instruction pipelining, pipeline hazards.

Memory Architecture: Storage systems, memory architecture (static and Dynamic RAM; row and column addressing; interleaving, banks), memory hierarchy: importance of temporal and spatial locality; main memory organization, cache memory: address mapping, block size, replacement, and store policies; virtual memory system: page table and TLB.

Interfacing and I/O Organization: External storage; Buses (daisy chaining; synchronous and asynchronous; point-to-point; PCI, PCIe); IO fundamentals: handshaking, buffering, programmed IO, interrupt driven IO; Interrupt handling

mechanism, Buses: protocols, arbitration, direct memory access.

Texts:

1. David A. Patterson and John L. Hennesy, Computer Organization and Design: The Hardware Software Interface, ARM Edition, 4th edition, Elsevier India, 2010.

References:

1. W. Stalling, Computer Organization and Architecture, PHI Publication
2. J.P. Hayes, Computer Architecture and Organization, Mc Graw Hill
3. A.S. Tanenbaum, Structured Computer Organization, PHI Publication

HSS Elective (HS)

Sl. No.	Course Code	Course Title	Hours per week			Credits	Branch	Preferred semester
			L	T	P			
1	HS351	Introduction to Linguistics	2	0	2	6	All	V
	HS352	Environmental Sciences	3	0	0	6	All	V
	HS353	Professional Ethics for Engineers/ Ethics and Human Values	3	0	0	6	All	V
2	HS361	Principles of Management	3	0	0	6	All	VI
	HS362	Entrepreneurship and Management Functions	3	0	0	6	All	VI
	HS363	Organizational Behaviour	3	0	0	6	All	VI

HS3093 INTRODUCTION TO LINGUISTICS 3-0-0-6

Historical Linguistics, Linguistic Typology: Language universals; the major language families; types of languages in the world (isolating, agglutinating, polysynthetic etc.); languages of India

Phonetics, Phonology, Morphology: The production of speech; the organs of speech; a phonetic description of speech sounds (vowels and consonants and their place and manner of articulation); combination of speech sounds; minimal pairs; free and bound morphemes; word building strategies; inflectional and derivational morphology

Syntax, Semantics: The structure of sentences and their constituents; basic sentence patterns; the subject, verb and object/ complement; IC Analysis; word meaning and sentence relations; sense relations (synonymy, homonymy etc)

Sociolinguistics, Applied Linguistics, Neurolinguistics: What is language/ mother-other tongue?; language, society and variation; basic concepts: language/ dialect/ sociolect/ idiolect/ style/ context/ register; methods

of teaching language; language and the brain

Text:

1. Murray, T. 1995.The Structure of English: Introduction to Phonetics, Phonology and Morphology. Boston: Allyn & Bacon
2. Mathews, P.H. 2003 Linguistics: A Very Short Introduction. Oxford University Press

References:

1. Fromkin, V., Rodman R. and Hyams, N. 2003. An Introduction to Language. Heinle and Thompson.
2. Radford, A., Atkinson, M., Britain, D., Clahsen, H. and Spenser, A. 2009 Linguistics: An Introduction. Cambridge University Press.
3. Additional reference material to be provided by Instructor.

HS3094	ENVIRONMENTAL SCIENCES	3-0-0-6

Environmental studies and Natural Resources:

Definition, scope and importance of environmental studies.

Natural Resources:

Renewable and non-renewable resources:

Natural resources and associated problems;

(a) Forest resources: Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forests and tribal people.

(b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems.

(c) Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources.

(d) Food Resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizers-pesticides problems, water logging, salinity.

(e) Energy Resources: Growing energy needs, renewable and non- renewable energy sources, use of alternate energy sources.

Eco Systems:

Concept of an eco-system, Structure and function of an eco-system, Producers, consumers, decomposers, Energy flow in the ecosystems, Ecological succession, Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystems:

(a) Forest ecosystem

(b) Grass land ecosystem

(c) Desert ecosystem.

(d) Aquatic eco systems (ponds, streams, lakes, rivers, oceans, estuaries)

Environmental Pollution:

Definition: Causes, effects and control measures of;

(a) Air pollution

(b) Soil pollution

(c) Marine pollution

(d) Noise pollution

(e) Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

Disaster management: Floods, earth quake, cyclone and landslides.

Social issues and the Environment:

From unsustainable to sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Environmental ethics: issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

Environment protection Act, Air (prevention and control of pollution) Act, Water (prevention and control of pollution) Act, Wildlife protection Act, Forest conservation Act, Issues involved in enforcement of environmental legislations.

Texts:

1. Textbook of Environmental studies, Erach Bharucha, UGC.
2. Fundamental concepts in Environmental Studies, D. D. Mishra, S Chand & Co Ltd.

HS3096	PRINCIPLES OF MANAGEMENT	3-0-0-6

Introduction of organisations and management, Concept of Industrial Management, Characteristics of Management, Management as an art – profession, Principles of Management, The evolution of management, Organisational environment, , Decision making- types, conditions and decision making process, Decision Making Aids.

Dimensions of P-O-L-C: Vision & Mission; Strategizing; Goal & Objectives; Organization Design, Culture, Human

Resource Management, Understanding Work Teams, Motivation, Leadership and Communication and Interpersonal Skills, foundation of Control.

Introduction to Functional areas of Management: Operations Management, Marketing Management, Financial Management.

Introduction to Entrepreneurship: Starts ups, Prospects & Challenges., Environmental Issues, CSR, Sustainability, The role of statistics for Industrial management: Simple Linear Regression and Correlation Assumptions and Properties of Least Square Estimator, Its Application by taking industrial data and its interpretations, Statistical

Software-Eview to be utilized to solve the industrial problems.

Text Books:

1. Koontz, H., and Weihrich, H., Essentials of Management: An International, Innovation and Leadership Perspective, 10th ed., McGraw Hill, 2015.
2. Robbins, SP, Bergman, R, Stagg, I, and Coulter, M, Management 7, Prentice Hall, 7th edition, 2015.
3. Richard I Levin, David S Rubin, Statistical management, 7th Edition, Prentice Hall India, 2011.
4. Kotler, P., Keller, Kevin Lane Keller et al. Marketing Management, 3rd Edition, 2016.
5. Eugene F. Brigham and Michael C. Ehrhardt, Financial Mangement: Theory and Practice, SouthWestern College Pub; 15th Edition, 2016.

Reference Books:

1. Mahadevan, B., Operations Management, Theory and Practice, Pearson Education Asia,
2. A. Aswathapa, Organizational Behaviour, 2010
3. Robert R. Reeder, Briety & Betty H. reeder, Industrial Marketing, Prentice Hall of India Pvt. Ltd, New delhi,2008.

HS3097 **ENTREPRENEURSHIP AND MANAGEMENT FUNCTIONS** 3-0-0-6

Unit I

What is Entrepreneurship? Who is an Entrepreneur? Meaning and Importance, Evolution, Influencing factors (Psychological, Social, Economic, and Environmental), Characteristics, Types of Entrepreneur (based on business, technology, motivation, growth, stages), Myths & Barriers.

Unit II

Meaning and concept of E-cells, advantages to join E-cell, significance of E-cell, various activities conducted by E-cell, case studies (including success and failure stories) and comparative analysis, Rules and Legislation (Applicability of Legislation: Central Excises Act, 1944, Industrial Disputes Act 1947, Factories Act, 1948, The sale of Goods Act, 1950, Industries Development (Regulations) Act, 1951, The industrial Employment (Standing Orders) Act, 1986; GST.

Unit III

Why to become entrepreneur, the skills/traits required to be an entrepreneur, creative and design; thinking, the entrepreneurial decision process, skill gap analysis, and role models, mentors and support system, introduction to various forms of business organization (sole proprietorship, partnership; corporations, Limited Liability company), mission, vision and strategy formulation.

Unit IV

Assistance to an entrepreneur; Industrial Park (Meaning, features & examples), Special Economic Zone (Meaning, features & examples), Financial assistance by different agencies, MSME Act small scale Industries, Carry on Business (COB) license, Environmental Clearance, National Small Industries Corporation (NSIC), Government Stores Purchase scheme (e-tender process), Excise exemptions and concession, Exemption from income tax, Quality Standards with special reference to ISO. Small Industries Development Bank of India (SIDBI), State Small Industries Development Corporation (SSIDC), Directorate General of Supplies and Disposals, Khadi and Village Industries Commission (KVIC)

Unit V

Importance of communication, barriers and gateways to communication, listening to people, the power of talk, personal selling, risk taking & resilience, negotiation.

Text Books:

1. Introduction to Entrepreneurship, Commonwealth of Learning

http://oasis.col.org/bitstream/handle/11599/2465/2011_VUSSC_intro-to-Entrepreneurship.pdf?sequence=1&isAllowed=y

Reference Books:

1. Entrepreneurship, Michael Laverty & Chris Littel https://openstax.org/books/entrepreneurship/pages/preface
2. Introduction to Entreneurship, Katherine Carpernter, University of Victoria. https://open.umn.edu/opentextbooks/textbooks/introduction-to-entrepreneurship

HS3098	ORGANIZATIONAL BEHAVIOUR	3-0-0-6

FUNDAMENTALS OF ORGANIZATIONAL BEHAVIOUR:

Understanding Organizational Behaviour - Fundamental Concepts, Organizational processes, Organizational structure, Organizational; Change and Innovation processes; Effectiveness in organizations - Models of Organizational Behaviour; Systems theory and time dimension of effectiveness, Developing, competencies, Limitations of Organizational Behaviour, Continuing challenges; Social systems and organizational culture - Understanding a Social System, Social Culture, Role, Status, Organizational culture, Influencing culture change, Sustaining the culture, Characteristics of effective socialization.

UNDERSTANDING AND MANAGING INDIVIDUAL BEHAVIOUR:

Individual differences and work behavior, Personality, Attitudes, Perceptions, Attributions and Emotions, Motivation, Job Design, Work and Motivation, Evaluation, Feedback and Rewards, Managing misbehavior, Stress and Counseling

GROUP BEHAVIOUR AND INTERPERSONAL INFLUENCE:

Informal and Formal Groups, Teams and Team Building, Managing Conflict and Negotiation, Power and Politics, Empowerment and Participation and Assertive Behaviour.

ORGANIZATIONAL PROCESSES:

Communication, Decision Making, Leadership

ORGANIZATIONAL DESIGN, CHANGE AND INNOVATION:

Organizational Structure and Design, Managing Change and Innovation

Text Books:

Reference Books:

1. Organizational Behaviour-Robbins, Judge & Sanghi, Pearson Education Publication.
2. Organizational Behaviour-McShane & Glinow, McGraw Hill Publication

HS3099	LANGUAGE, COGNITION AND CULTURE	3-0-0-6

Language evolution: Form and content; ways of thinking; role of meaning in comprehension

Cognitive and semantic issues: Structural and linguistic issues; categorization, metaphor and mental imagery; sense relations; spatial and temporal language

Socio-cultural issues: Embodiment, universalism / relativism, schemas; kinship relations

Theoretical perspectives: Various approaches and views; Separate Worlds Hypothesis; Gender Theory; Speech Act Theory; Gricean Maxims; Performative Theory etc.

Text Books:

1. A. Akmajian, R. A. Demers, A. K. Farmer, R. M. Harnish. 2001. Linguistics: An Introduction to Language and Communication. (PART II: 'Communication and Cognitive Science'). MIT Press, London.
2. Croft, W. and D.A. Cruse. 2004. Cognitive Linguistics, Cambridge University Press.
   (Select papers (Langacker, Harris, van Djik etc) to be provided by Instructor)

References:

1. Friedenberg, J. and Silverman, G. 2006. Cognitive Science: An Introduction to the Study of Mind. Sage Publications, Thousand Oaks, California.
2. Albertazzi, L. 2000. Meaning and Cognition: A Multidisciplinary Approach. John Benjamins Publishing Company.
3. Gumperz, J. and Levinson, S. C. 1996. Rethinking Linguistic Relativity. Cambridge University Press.
   Sunderland, J. 2006. Language and Gender: An Advanced Resource Book. Routledge, New York.