DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNDER GRADUATE (B.Tech.) SYLLABUS 2024 Onwards Admission Batches

Third Semester

Name of Program	B.Tech (Electronics & communications)	**Semester-III**	**Session 2024-Onwards**
Name of Course	Applied Numerical Methods		
Course Code	MTH231		
Core / Elective / Other	Core		

Prerequisite:	
1.	Knowledge of Engineering Mathematics up to B.Tech. I year
2.	Basic knowledge of probability
Course Outcomes:	
	Apply suitable numerical techniques for real-world problem related to Electronics & Communication Engineering
Description of Contents in brief:	
1.	Mean, median, mode and standard deviation, Correlation and regression analysis.
2.	Combinatorial probability, probability distribution functions-binomial, Poisson, exponential and normal, Joint and conditional probability
3.	Introduction to group theory, vector spaces, subspaces, algebra of subspaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces, Diagonalization of a matrix.
4.	Numerical solutions of algebraic and transcendental equations: bisection, secant method, Newton-Raphson method, fixed point iteration
5.	Numerical solution of initial value problems of ODEs: Euler's method, Runge-Kutta methods, convergence criteria.
List of Text Books:	
1.	Numerical Methods by Dr. B. S. Grewal
2.	Mathematical Statistics-Ray, Sharma and Chaudhary
3.	Advanced Engineering Mathematics by Erwin Kreyszig
4.	Linear Algebra and Its Applications- Gilbert Strang
List of Reference Books:	
1.	Introduction to Mathematical Statistics-Hogg, R. V. and Craig, A., Pearson Education, 6th edition 2006.
2.	Linear Algebra- Hoffman, K. and Kunze, R., 2nd edition, Pearson Education (Asia) Pvt. Ltd/ Prentice Hall of India 2004.
3.	Contemporary Abstract Algebra- Gallian J. A., 8th edition Cengage Learning 2013.
4.	Applied Numerical Analysis- Gerald, C. F. and Wheatly, P. O., 6th edition, Wesley 2002.
5.	Numerical Methods for Scientific and Engineering Computation- Jain, M. K., Iyengar, S. R. K. and Jain, R. K., New Age Pvt. Publisher, New Delhi 2000.
URLs:	
1.	https://nptel.ac.in/courses/111/107/111107105/

2.	https://nptel.ac.in/courses/111/105/111105041/
3.	https://nptel.ac.in/courses/111/105/111105112/
Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**
1.	Average of central tendency as Mean, median and mode
2.	Problems based on Mean, median and mode
3.	Problems based on Mean, median and mode
4.	Combinatorial probability
5.	Probability distribution functions
6.	Probability distribution functions Poisson Distribution
7.	Problems on Poisson Distribution
8.	Exponential Distribution
9.	Normal Distribution
10.	Joint and conditional probability
11.	Problems based on Joint and conditional probability
12.	Problems based on Joint and conditional probability
13.	Correlation & regression
14.	Problems on Correlation & regression analysis
15.	Introduction to group theory
16.	Based problem on group theory
17.	Vector spaces
18.	Examples of Vector space
19.	Subspaces
20.	Algebra of subspaces
21.	Linear combination of vectors
22.	Linear span
23.	Linear independence
24.	Basis & Dimension
25.	Problems on Basis & Dimension
26.	Dimension of subspaces
27.	Diagonalization of a matrix
28.	Problems on Diagonalization of a matrix
29.	Roots of Algebraic and transcendental equations, Bisection Method
30.	Bisection Method
31.	Secant Method
32.	Problems on Secant Method
33.	Newton Raphson Method
34.	Newton Raphson Method
35.	Fixed point iteration
36.	Numerical solution of initial value problems of ODEs Euler's method
37.	Problems on Euler's method
38.	Runge-Kutta methods
39.	Problems on Runge-Kutta methods
40.	Convergence criteria

Name of Program	B.TECH	**Semester** III	**Year** II

Name of Course	Electronics Circuits and Devices
Course Code	ECE211
Core / Elective / Other	Core

Prerequisite:	
1.	Semiconductor Devices and Physics
2.	Basic Network Analysis
3.	Basic Electronics Engineering
Course Outcomes: After completion of the course student will be able to:	
1.	Study, Analyses, Design & Compare different types of transistor configurations.
2.	Describe the different Biasing of FETs, MOSFET for their applications.
3.	Discuss & Construct different Power semiconductor devices like SCR, DIAC, TRIAC, UJT and testing their VI characteristics in laboratory for different applications.
4.	Demonstrate and interpret different small signal low frequency and high frequency analysis BJT different configurations & discuss different design.
5.	Discuss and design different power amplifier for different class to construct & illustrate different class of power amplifiers for real applications.
6.	Design, implement & illustrate different wave shaping circuits.
Description of Contents in brief:	
1.	Modeling devices: Static characteristics of ideal two terminal and three terminal devices; Small signal models of non-linear devices.
2.	Introduction to semiconductor equations and carrier statistics: Poisson's and continuity equations, Fermi-Dirac statistics and Boltzmann approximation to the Fermi Dirac statistics
3.	Semiconductor Diodes: Barrier formation in metal semiconductor junctions, PN homo and hetero- junctions; CV characteristics and dopant profiling; IV characteristics; Small signal models of diodes; Some Applications of diodes.
4.	Field Effect Devices: JFET/HFET, MIS structures and MOSFET operation; JFET characteristics and small signal models; MOS capacitor CV and concept of accumulation, depletion and inversion; MOSFET characteristics and small signal models.
5.	Bipolar transistors: IV characteristics and Ebers-Moll model; small signal models; Charge storage and transient response.
6.	Discrete transistor amplifiers : Common emitter and common source amplifiers; Emitter and source followers.
List of Text Books:	
1.	Microelectronic Devices- Dipankar Nag Choudhary
2.	Fundamentals of semiconductor devices – M K Achuthan, K N Bhat
3.	Solid State Electronic Devices- D K Bhattcharya, Rajnish Sharma
List of Reference Books:	
1.	D. A. Neamen, Semiconductor Physics and Devices (IRWIN), Times Mirror High Education Group, Chicago, 1997.

2.	E.S. Yang, Microelectronic Devices, McGraw Hill, Singapore, 1988.
3.	B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi, 1995.
4.	J. Millman and A. Grabel, Microelectronics, McGraw Hill, International, 1987.
5.	A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.
6.	R.T. Howe and C.G. Sodini, Microelectronics : An integrated Approach, Prentice Hall International, 1997.
URLs:	
1.	http://class.ece.iastate.edu/ee230/
2.	http://inst.eecs.berkeley.edu/~ee130/archives.html
3.	http://class.ece.iastate.edu/ee330/

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1.	Basic introduction about the subject.
2.	Modeling devices
3.	Static characteristics of ideal two terminal devices.
4.	Static characteristics of ideal three terminal devices.
5.	Small signal models of non-linear devices.
6.	Contd. Small signal models of non-linear devices.
7.	Introduction to semiconductor equations.
8.	Introduction to carrier statistics.
9.	Poisson's equations.
10.	Continuity equations.
11.	Fermi-Dirac statistics.
12.	Contd. Fermi-Dirac statistics.
13.	Boltzmann approximation to the Fermi Dirac statistics.
14.	Semiconductor Diodes.
15.	Barrier formation in metal semiconductor junctions.
16.	PN homo-junctions.
17.	PN hetero-junctions.
18.	CV characteristics.
19.	Dopant profiling.
20.	IV characteristics of FET
21.	Small signal models of diodes.
22.	Some Applications of diodes.
23.	Field Effect Devices : JFET.
24.	Field Effect Devices : HFET.
25.	MIS structures.
26.	MOSFET operation.
27.	JFET characteristics.
28.	Small signal models.
29.	Bipolar transistors.
30.	IV characteristics.
31.	Elers-Moll model.
32.	Small signal models.
33.	Charge storage.

34.	Transient response.
35.	Discrete transistor amplifiers.
36.	Common emitter.
37.	Contd. Common emitter.
38.	Common source amplifiers.
39.	Emitter followers.
40.	Source followers.

Name of Program	B.Tech	**Semester** III	**Year** II

Name of Course	Digital Circuit Design
Course Code	ECE212
Core / Elective / Other	Core

Prerequisite:	
1.	Basic knowledge of electronic circuits
2.	
3.	

Course Outcomes:	
1.	To acquire the basic knowledge of digital logic levels and application of knowledgeto understand digital electronics circuits.
2.	To impart how to design Digital Circuits
3.	To design and analyses synchronous and asynchronous sequential circuits

Description of Contents in brief:	
1.	Number systems, reduction of logical expressions using boolean algebra, k-map and tabulation method
2.	Combinational circuits Design
3.	Sequential Circuit Design
4.	Registers, Counters, State machines
5.	Logic families: RTL, DTL, TTL, STTL, ECL, I^2L, basic gates.
6.	parameters of logic Families: fan-in, fan-out , power dissipation, noise margin, delay calculation.

List of Text Books:	
1.	M. Moris Mano, Digital Logic and Comuter Design, Pearson Education, New Delhi, , 2012
2.	Zvi. Kohavi, Switching and Finite Automata Theory, Tata McGraw Hill, New Delhi
3.	Gupta BR, Digital Electronics, SK Kataria Publishers, 2009

List of Reference Books:	
1.	Digital Logic and Computer Design M.MorrisMeno, Pearson Education
2.	Digital Fundamentals Floyd and Jain, Pearson Education
3.	Digital Electronics Principles and integrated Circuits A.K.Maini, Wiley India
4.	Modern Digital Electronics RP Jain
5.	Fundamentals of digital circuits A Anand Kumar, PHI

URLs:

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1	Introduction to digital systems, Difference between analog and digital systems Applications of digital systems
2	Review of number systems Decimal number system,9's and 10's complements, Arithmetic operations using 9's and 10's complements

3	Binary, Octal and Hexa Decimal number systems, Conversion methods from one base to another base
4	complements- signed and unsigned Binary numbers Weighted and non-Weighted codes – ASCII code
5	Binary codes: BCD Code, Gray Code, XS-3 code Applications of BCD, Gray and XS-3 codes
6	BCD and XS-3 Addition and subtraction
7	Error detecting and Error correcting codes- hamming codes
8	Examples on Error Detecting and Correcting codes
9	Boolean postulates and laws–
10	De-Morgan's Theorem- proof
11	Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive – OR and Exclusive – NOR.
12	Representation of a Boolean function (Truth table, Min term, Maxterm)
13	Implementations of Logic Functions using basic gates, NAND –NOR implementations
14	Minimization of Boolean expressions – Sum of Products (SOP) –Product of Sums (POS)-
15	Canonical forms – Conversion from one canonical form to another
16	Karnaugh map Minimization – 2,3&4 variables
17	Boolean simplification using Don't care terms
18	QuineMc'Clusky method of minimization
19	Introduction to combinational logic, Adder-Substractor: Half adder, Full Adder
20	Half subtractors, Full Subtractors
21	Types of adders: Serial, Parallel, Carry look ahead,BCD Adder
22	Comparator, Multiplexer, Demultiplexer
23	Encoder, Decoder
24	Code Converters: Binary to Grey, Grey to Binary
25	Design of Code Converters Using MUX and Decoder
26	Difference between Combinational and sequential circuits. Latches
27	Flip-Flops- SR Flip flop, JK Flip-flop
28	T flip-flop, D flip-flop
29	Master slave Flip flops – Characteristic table and equation
30	Application table– Edge triggering –Level Triggering
31	Realization of one flip flop using other flip flops
32	Asynchronous / Ripple counters – Synchronous counters
33	Modulo – n counter
34	Classification of sequential circuits
35	Analysis of clocked sequential circuits: State equation- State table
36	State diagram –State reduction and State assignment
37	Register – shift registers- Universal shift register – Shift counters
38	Basic PLDs: ROM, PROM, Functions devices Realising using ROM, PLA, PAL
39	Realization of Switching Functions using PLA
40	Realization of Switching Functions using PAL,FPGA, CPLDs

Name of Program	B.TECH	**Semester** III	**Year** II

Name of Course	Network Analysis And Synthesis
Course Code	ECE 213
Core / Elective / Other	Core

Prerequisite:	
1.	**None**
2.	

Course Outcomes:	
1	Apply the knowledge of basic circuital law and simplify the network using reduction techniques
2	Analyze the circuit using Kirchhoff's law and Network simplification theorems
3	Infer and evaluate transient response, Steady state response, network functions
4	Obtain the maximum power transfer to the load , and Analyze the series resonant and parallel resonant circuit
5	Evaluate two-port network parameters , design attenuators and equalizers
6	Synthesize one port network using Foster and Cauer Forms

Description of Contents in brief:	
	Analysis: Review of kirchhoff's laws and circuit elements, Graph theory, Lattice and bridge T networks, coupled circuits, Network theorems, Differential equations: description of first and second order systems, Laplace transform and its applications in circuit analysis, Two port networks, properties of Network Functions. Synthesis: Synthesis of passive networks, Hurwitz polynomial, PR funtions, realization of LC, RL, RC network by foster and cauer form.

List of Text Books:	
1.	None

List of Reference Books:	
1.	Network Analysis by Van Vulkenburg
2.	Circuit Theory (Analysis and Synthesis) A.Chakrabarti
3.	Engineering Circuit Analysis William H. Hayt& Jack E. Kemmerly
4.	Kuo F. F., "Network Analysis and Synthesis", 2nd Ed., Wiley India., 2008.

URLs:	
1.	

Lecture No.	**Topic**
1	Review of KCL and KVL
2	Circuit elements, Ideal sources - Dependent and Independent sources
3	Formation of matrix equations and analysis of complex circuits using mesh-current method

4	Formation of matrix equations and analysis of complex circuits using nodal voltage method
5	Graph theory
6	Graph theory
7	Thevenin's Theorem, Norton's Theorem
8	Thevenin's Theorem, Norton's Theorem
9	Superposition theorem, Reciprocity theorem
10	Maximum power transfer theorem
11	Compensation theorem
12	Tellegen's theorem &millman's theorem
13	Faradays laws of electromagnetic induction, Concept of self and mutual inductance
14	Dot convention, coefficient of coupling, analysis of series magnetic circuit
15	Analysis of parallel magnetic circuit, composite magnetic circuit and various problems
16	First order differential equations and initial conditions
17	First order differential equations and initial conditions
18	Transient response of series RLC circuit
19	Transient response of series RL circuit
20	Transient response of series LC circuit
21	Second order differential equations
22	First order differential equations and initial conditions
23	Laplace transform
24	Laplace transform
25	Laplace transform
26	Network analysis- Network synthesis- Definitions, Network functions of one port and two port networks
27	Poles and Zeros of network functions
28	Two port Parameters: z, y, h, inverse-h, ABCD parameters
29	Causality and Stability analysis of network functions
30	Hurwitz polynomial
31	Positive Real Functions.
32	Properties and Synthesis of LC driving point immittance function by foster forms
33	Properties and Synthesis of driving point RC function by foster forms
34	Properties and Synthesis of driving point RC function by foster forms
35	Properties and Synthesis of driving point RL function by foster forms
36	Properties and Synthesis of driving point RL function by foster forms
37	Properties and Synthesis of LC driving point immittance function by cauer forms
38	Properties and Synthesis of LC driving point immittance function by cauer forms
39	Properties and Synthesis of driving point RC function by cauer forms
40	Properties and Synthesis of driving point RL function by cauer forms

Name of Program	B.TECH	**Semester** III	**Year** II

Name of Course	Signals & Systems
Course Code	ECE 214
Core / Elective / Other	Core

Prerequisite:

1.	Nil
2.	
3.	

Course Outcomes:

1.	Various classifications of both Continuous time and Discrete time Signals and Systems.
2.	Spectral analysis of Periodic and Aperiodic Signals using Fourier series.
3.	Analysis and characterization of the CT system through Laplace transform and Fourier transform.
4.	Analysis and characterization of the DT system through classical method.
5.	Analysis and characterization of the DT system through Z transform.

Description of Contents in brief:

1.	Signals in Natural Domain, Introduction, Description of Signals, Basic Signals in Detail, Different operations on signals, Description of Systems, Properties of Systems, Classification of Systems
2.	Continuous LTI Systems, Properties of LTI Systems, Differential and Difference Equations, Linear Shift Invariant Systems and their properties
3.	Signals in Frequency Domain, Fourier Series and its properties, Introduction to Transformations -Fourier Transform, and its Properties, Application of Fourier Transform in System analysis, Convolution , Correlation, Hilbert Transform
4.	Laplace Transform and its properties, Region of convergence, Analysis and characterization of LTI system using Laplace Transform
5.	Sampling and Reconstruction of Band-Limited Signals, Discrete time Fourier transform and its Properties, Z Transform and its Properties, Region of Convergence, Application in Discrete system Analysis

List of Text Books:

1.	A. V. Oppenheim, A. S. Willsky and S. H. Nawab, Signals and Systems, 2nd Ed., Pearson Prentice Hall, 2008.
2.	B.P. Lathi, "Principles of Linear Systems and Signals" Oxford , 2009.
3.	S. Haykin and B. V. Veen, "Signals and Systems," 2nd Ed., Wiley India, 2007.

List of Reference Books:

1.	H. P. Hsu, "Signals and Systems – Schaum's Outline Series," McGraw Hill, 1995.
2.	John.G.Proakis and Manolakis " Digital Signal Processing-Principles ,Algorithms and Applications" , Pearson Education ,4th Edition 2009.
3.	Rodger E Ziemer, William H. Tranter, D. Ronald Fannin, "Signals and Systems – continuous and Discrete", Pearson Education, 4th Edition, 2009.
URLs:	
1.	
2.	
3.	

Lecture Plan (about 40-50 Lectures):

Lecture No.	Topic
1.	Introduction to Signals and Systems
2.	Continuous time signals (CT signals), discrete time signals (DT signals)
3.	Periodic and non periodic signals
4.	Energy and power signals
5.	Deetrministic and random signals
6.	Basic operations on Signals: Time shifting and Time reversal
7.	Basic operations on Signals: Time Scaling
8.	Some important signals: Unit Step; Unit Ramp; Unit Impulse
9.	Sampling and Derivatives of Impulse signals
10.	TUTORIAL
11.	Classification of Systems – Linear and Non-Linear, Time Variant and Time Invariant
12.	Classification of Systems – Causal and Non-causal, Stable and Unstable, Static and Dynamic.
13.	TUTORIAL
14.	Continuous LTI Systems
15.	Continuous LTI Systems Properties
16.	Convolution
17.	Correlation
18.	Linear Shift Invariant Systems
19.	Linear Shift Invariant SystemsPropperties
20.	TUTORIAL
21.	Fourier series analysis
22.	Properties of Fourier Series Analysis
23.	Problems on Fourier series
24.	TUTORIAL
25.	Fourier Transform analysis
26.	Properties of Fourier Transform
27.	Problems on Fourier Transform
28.	Application of Fourier Transform in system analysis
29.	TUTORIAL

30.	Laplace Transform
31.	Properties of Laplace Transform
32.	Problems on Laplace Transform
33.	Problems on Inverse Laplace Transform
34.	Application of Laplace Transform in system analysis
35.	TUTORIAL
36.	Analysis of discrete time signals: DTFS,DTFT
37.	Properties of DTFT and problems
38.	Z-transform and ROC
39.	Properties of Z-transform and problems
40.	TUTORIAL

FOURTH SEMESTER

Name of Program	B.TECH	**Semester** IV	**Year** II
Name of Course	Fundamentals of Entrepreneurship		
Course Code	HUM 251		
Core / Elective / Other	Core		

Prerequisite:

1.	Organizational theories and Motivation for Entrepreneurship enthusiastic for systematic approach to handle the materialistic and non-materialistic motivation.
2.	Business Plan and fundamentals of Entrepreneur Development for engineering graduates to survive in this competitive world.
3.	A hybrid approach for technocrats to handle the multifunctional technicalities in case of industrial laws and New social security and pension rules.

Course Outcomes:

1.	Course will inculcate administrative skills for Engineers to handle the all the matters related to personnel and their dimensions.
2.	Engineering students will be in position to take appropriate decision to understand the industrial Laws and application of administrative principles for smooth functioning of Industry and a fresh idea to setup new business.
3.	Boost up the engineers to develop Business ideas to become successful entrepreneurs to setup new operational business units to address the need of society.

Description of Contents in brief:

1.	Meaning, nature and scope of Personnel Administration in India, functions and significance of Personnel Administration, Recruitment, Training, Promotion and Disciplinary Action, Classification of Services, Generalists and Specialists, Development of Public Services in India, Bureaucracy and Modern Democratic System, Performance Appraisal
2.	Organizational Development Theories, Fredric Winslow Taylor, Marry Parker Follett, Elton Mayo, Max Weber, Henry Fayol, Power, Accountability, Responsibility, Control, Transparency and Conflict Resolutions
3.	Meaning and importance of Entrepreneurship, Evolution of Entrepreneurship, Factors influencing Entrepreneurship: Social factors, psychological factors, economical factors and environmental factors. Characteristics of an Entrepreneur, Types of Entrepreneur: type of business, use of technology, motivation. New Generation of entrepreneurship: social entrepreneurship, tourism entrepreneurship, women entrepreneurship. Barriers to Entrepreneurship.
4.	Entrepreneurial motivation: Relevance of Motivation, Maslow's Theory, Herzberg's Theory, Douglas McGregor, Ethics, Corruption and Anti-Corruption Machinery in country
5.	Factory Act 1948, Provident Fund Act 1952, Compensation Act 1919, Special Economic Zone (SEZ), National Small Industries, Quality Standard with Special reference to (ISO), Small Industries Development Bank of India (ISDBI), New Pension Scheme 2004 Act.

List of Text Books:

1.	D. Ravindra Prasad, V.S. Prasad, P. Satyanarayana, Y. Pardhasaradhi. Administrative Thinkers. Sterling Publishers Private Limited Second Revised Enlarged Edition, New Delhi. 2010.
2.	Haidi, Patricia & Brush, Teaching Entrepreneurship, Edward Elgar, United States of America, 2014.
3.	Norma M. Riccucci, Public Personnel Management, Rutledge, United States of America, 2017.
4.	Padhi, Labour& Industrial Laws, PHI Learning Private Limited, Eastern Economy Edition. New Delhi,2017

List of Reference Books:

1.	Monappa&Saiyadain, Personnel Management, McGraw Hills, January-2001.
2.	Howard & Donald, Entrepreneurship: Theory, Process &Practice, engage Learning, Australia, 2010.
3.	Jared, Donald & John, Public Personnel Management, Rutledge, United Kingdom,2018
4.	Sinha&Sekhar, Industrial Relations, Trade Unions and Labor Legislations,Pearson Publication,New Delhi.2017

URLs:

1.	https://www.google.com/search?ei=soDDXtS_G4ma4-EPo8CFyAs&q=entrepreneurship+development&oq=entreprenurship&gs_lcp=CgZwc3ktYWIQARgCMgQIABAKMgQIABAKMgQIABAKMgQIABAKMgQIABAKMgQIABAKMgQIABAKMgQIABAKMgQIABAKOgQIABBHOgQIABBDOgIIADoOCAAQ6gIQtAIQmgEQ5QI6BQgAEJECOgUIABCDAToJCAAQChBGEPkBUKAiWJd5YNKgAWgBcAF4A4ABoAGIAcESkgEEMC4xOZgBAKABAaoBB2d3cy13aXqwAQY&sclient=psy-ab
2.	https://www.google.com/search?ei=soDDXtS_G4ma4-EPo8CFyAs&q=personnel+administration&oq=personnel+administartaion&gs_lcp=CgZwc3ktYWIQARgAMgQIABANMgQIABANMgQIABA
3.	https://www.google.com/search?ei=soDDXtS_G4ma4-EPo8CFyAs&q=industrial+laws+in+india&oq=industrial+laws&gs_lcp=CgZwc3ktYWIQARgBMgIIADICCAAyAggAMgIIADICCAAyAggAMgIIADICCAAyAggAOgQIABBHOgQIABBDOg4IABDqAhC0AhCaARDlAjoFCAAQgwE6BQgAEJECUJoYWKRBYKNkaAFwAXgDgAGRAYgB1BCSAQQwLjE5mAEAoAEBqgEHZ3dzLXdperABBg&sclient=psy-ab
4.	https://www.amazon.in/Industrial-Relations-Unions-Labour-Legislation-ebook/dp/B073TZDYGM/ref=pd_simd_14_1/257-1509110-0248531?_encoding=UTF8&pd_rd_i=B073TZDYGM&pd_rd_r=89ddebbb-c2da-4413-97cf-3dfb96f9d746&pd_rd_w=Sd4l2&pd_rd_wg=WvAxZ&pf_rd_p=189ccf44-51b2-4146-8c7f-876b3263b44b&pf_rd_r=TWD32YRDW3JPK75NA49K&psc=1&refRID=TWD32YRDW3JPK75NA49K

Name of Program	B.Tech	**Semester** IV	**Year** II

Name of Course	Digital Signal Processing
Course Code	ECE 221
Core / Elective / Other	Core

Prerequisite:

1.	Signals and linear systems theory
2.	Laplace and Fourier transform
3.	Electric Circuit Theory

Course Outcomes:

1.	To acquire the knowledge about discrete-time sequences, frequency analysis and LTI system.
2.	To acquire the knowledge of DTFT, DFT and their corresponding properties.
3.	To understand the significance of z-transform in discrete systems.
4.	Ability to design different types of digital filters both FIR and IIR.

Description of Contents in brief:

1.	Discrete Time Fourier Transform(DTFT): Concept of frequency in discrete and continuous domain and their relationship (radian and radian/sec), freq. response in the discrete domain. Discrete system's response to sinusoidal/complex inputs (DTFT), Representation of LTI systems in complex frequency domain.
2.	Z- Transforms: Definition, mapping between s-plane & z-plane, unit circle, convergence and ROC, properties of Z-transform, Z-transform on sequences with examples & exercises, characteristic families of signals along with ROC, convolution, correlation and multiplication using Z- transform, initial value theorem, Perseval's relation, inverse Z-transform by contour integration, power series & partial-fraction expansions with examples and exercises.
3.	Discrete Fourier Transform: Concept and relations for DFT/IDFT, Relation between DTFT & DFT. Twiddle factors and their properties, computational burden on direct DFT, DFT/DFT as linear transformation, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circulation convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences-Overlap-Save and Overlap-Add methods with examples and exercises.
4.	Fast Fourier Transforms: Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithm, signal flow graph, Butterflies, computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations and exercises.
5.	Filter design: Basic concepts of IIR and FIR filters, difference equations, design of Butterworth IIR analog filter using impulse invariant and bilinear transform, design of linear phase FIR filters no. of taps, rectangular, Hamming and Blackman windows.

	Effect of quantization, Applications of DSP

List of Text Books:

1.	Discrete-Time Signal Processing by A. V. Oppenheim and R. W. Schafer.
2.	Digital Signal Processing: Principles, Algorithms, and Applications by J. G. Proakis and D. G. Manolakis.
3.	Digital Signal Processing by Schaums Series, TMH.

List of Reference Books:

1.	Theory and Application of Digital Signal Processing by Rabiner and Gold.
2.	Introduction to digital signal processing, Johnny R. Johnson.
3.	Digital Signal Processing: S. Mitra

URLs:

1.	https://nptel.ac.in/courses/117102060/
2.	https://nptel.ac.in/courses/108106151/
3.	https://nptel.ac.in/courses/108105055/

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1.	Introduction of Analog and Digital Signal Processing
2.	Representation and Analysis of discrete system
3.	discrete time signal & systems
4.	LTI systems and their properties, Linear Convolution
5.	linear constant-coefficient difference equations
6.	Representation of recursive and non recursive system.
7.	Tutorial
8.	Z Transform
9.	One sided and Two sided Z Transform
10.	Properties of Z Transform
11.	Properties of Z Transform
12.	properties of ROC for Z–transform
13.	Inverse Z Transform
14.	Realizable Systems, Stability & Causality
15.	Inverse System, Pole zero cancellation in system function
16.	Tutorial
17.	Introduction to Discrete Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT)
18.	Relation between DTFT and DFT,
19.	Properties of DFT
20.	Linear and Circular Convolution
21.	Fast Fourier Transform (FFT)
22.	FFT Computation using Decimation in time – Radix 2 FFT algorithm
23.	Tutorial
24.	FFT Computation using Decimation in frequency – Radix 2 FFT algorithm
25.	Tutorial
26.	Composite Radix FFT

27.	Design of analog Butterworth Filter
28.	Design of analog Chebyshev Filter
29.	Frequency transformation in analog domain Design of IIR digital filters using impulse invariance technique,
30.	Design of IIR digital filters using bilinear transformation
31.	Tutorial
32.	Realization using Direct form I
33.	Realization using Direct form II
34.	Realization using cascade forms
35.	Realization using Parallel forms
36.	Realization of FIR Filter
37.	Tutorial
38.	Linear Phase FIR filters, Problems on Linear phase FIR filter, Gibbs phenomenon
39.	Design of FIR filter using windowing techniques – Hamming, Hanning and Blackmann windows
40.	Design of FIR filter using windowing techniques Blackmann windows
41.	Design of FIR filter using Frequency Sampling method
42.	Tutorial
43.	Application of DSP in Communication
44.	Application of DSP in Biomedical
45.	Application of DSP in Image Processing
46.	DCT and Wavelet Transform

Name of Program	B.TECH	**Semester** IV	**Year** II
Name of Course	LINEAR INTEGRATED CIRCUITS		
Course Code	ECE 222		
Core / Elective / Other	Core		

Prerequisite:	
1.	Basic Network Analysis.
2.	
3.	
Course Outcomes: After completion of the course student will be able to:	
1.	Describe and discuss importance of feedback in amplification.
2.	Differential amplifier, configuration and applications .
3.	Basic building block of OP-AMP ,OPAMPS parameters, ideal and non idealopams amplifiers and comparison.
4.	Design, Analyze and Categorized different linear circuits and applications using opams .
5.	Explain & Discuss Understating of analog filters ,Introduction to ADCs and DACS and designing .
6.	Simulate and verify the functionality of BJT, JFET & MOSFET and opams circuits using PSpice.
Description of Contents in brief:	
1.	Introduction to operational amplifiers: The difference amplifier and the ideal operational amplifier models, concept of negative feedback and virtual short ; Analysis of simple operational amplifier circuits; Frequency response of amplifiers, Bode plots.
2.	Feedback: Feedback topologies and analysis for discrete transistor amplifiers; stability of feedback circuits using Barkhausen criteria.
3.	Linear application operational amplifiers: Instrumentation and Isolation amplifiers; Current and voltage sources; Active filters.
4.	Non-linear applications of operational amplifiers: Comparators, clippers and clampers; Linearization amplifiers; Precision rectifiers; Logarithmic amplifiers, multifunction circuits and true rms convertors.
5.	Waveform Generation: sinusoidal feedback oscillators; Relaxation oscillators, square triangle oscillators. Real operational amplifiers: Current sources and active loads, difference, intermediate and output stages including Miller capacitors for frequency computation; Operational amplifier parameters; Effects of real operational amplifier parameters on circuit performance.
6.	Analog and Digital interface circuits: A/D, D/A Converters, S/H circuits and multiplexers.
List of Text Books:	
1.	Microelectronic Circuits: Theory and Applications, Adel S.Sedra, Kenneth C. Smith, ArunN.Chandorkar.
2.	Microelectronics Circuits Analysis and Design, Muhammad H.Rashid
3.	

List of Reference Books:	
1.	Introduction to Operational J.V. Wait, L.P. Huelsman and GA Korn, Amplifier theory and applications 2nd edition, McGraw Hill, New York, 1992.
2.	Microelectronics J. Millman and A. Grabel, 2nd edition, McGraw Hill, 1988.
3.	The Art of Electronic P. Horowitz and W. Hill, 2nd edition, Cambridge University Press, 1989.
4.	Microelectronic Circuits A.S. Sedra and K.C. Smith Saunder's College Publishing, 1991.
URLs:	
1.	http://class.ece.iastate.edu/ee435/
2.	https://people.eecs.berkeley.edu/~pister/140sp20/
3.	http://class.ece.iastate.edu/ee508/

Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**
1.	Basic introduction about the subject.
2.	Introduction to operational amplifiers.
3.	The difference amplifier.
4.	The ideal operational amplifier models.
5.	Concept of negative feedback.
6.	Concept of virtual short.
7.	Analysis of simple operational amplifier circuits.
8.	Contd. Analysis of simple operational amplifier circuits.
9.	Frequency response of amplifiers.
10.	Bode plots.
11.	Contd. Bode plots.
12.	Feedback.
13.	Feedback topologies.
14.	Analysis for discrete transistor amplifiers.
15.	Stability of feedback circuits using Barkhausen criteria.
16.	Linear application operational amplifiers.
17.	Instrumentation amplifiers
18.	Isolation amplifiers.
19.	Linear application operational amplifiers.
20.	Current sources.
21.	voltage sources.
22.	Active filters.
23.	Non-linear applications of operational amplifiers
24.	Contd. Non-linear applications of operational amplifiers.
25.	Comparators.
26.	Clippers.
27.	Clampers.
28.	Linearization amplifiers.
29.	Precision rectifiers.
30.	Logarithmic amplifiers.
31.	Multifunction circuits and true rms convertors.
32.	Waveform Generation: sinusoidal feedback oscillators.
33.	Relaxation oscillators.

34.	Square triangle oscillators.
35.	Real operational amplifiers: Current sources and active loads, difference.
36.	Intermediate and output stages including Miller capacitors for frequency computation.
37.	Operational amplifier parameters; Effects of real operational amplifier parameters on circuit performance.
38.	Analog and Digital interface circuits: A/D Converters.
39.	D/A Converters.
40.	S/H circuits and multiplexers.

Name of Program	B.TECH	**Semester** IV	**Year** II

Name of Course	Microprocessors and Microcontrollers
Course Code	ECE 223
Core / Elective / Other	Core

Prerequisite:

1.	Digital Electronics
2.	
3.	

Course Outcomes:

1.	Recall and apply a basic concept of digital fundamentals to Microprocessor based personal computer system.
2.	Identify a detailed s/w & h/w structure of the Microprocessor.
3.	Illustrate how the different peripherals (8255, 8253 etc.) Are interfaced with microprocessor.
4.	Distinguish and analyze the properties of Microprocessors & Microcontrollers.
5.	Analyze the data transfer information through serial & parallel ports.

Description of Contents in brief:

1.	Evolution of Microprocessor, Microprocessor 8085 - internal architecture, Memory Mapping, Instruction set and assembly language programming.
2.	Introduction to 8086 microprocessor - internal architecture, pin description, memory segmentation, addressing modes, instruction set and assembly language programming.
3.	Basic Interfacing devices: Memory interfacing, 8255, 8253, 8259, 8257, 8251, Interfacing A/D and D/A converters, Case studies of microprocessor based systems.
4.	Salient features of advanced microprocessors: 80286,386,486,Pentium, Concept of CISC and RISC processors, Introduction to ARM processor.
5.	Introduction to 8051 microcontrollers, its architecture, pin description, I/O configuration, interrupts, addressing modes, an overview of 8051 instruction set, Microcontroller applications.

List of Text Books:

1.	R. S. Gaonkar, Microprocessor Architecture Programming and Applications, 2 nd Ed, New Age International Publishers, 1995.
2.	Douglas V. Hall, SSSP Rao, Microprocessors and Interfacing, Third Edition, McGrawHill Education.
3.	Kenneth J Ayala, The 8051 Microcontroller , (3/e), Thomson Delmar Learning, 2004.

List of Reference Books:

1.	M.A. Mazidi& J.C. Mazidi Microcontroller and Embedded systems using Assembly &

	C. (2/e), Pearson Education, 2007.
2.	J.L. Antonakos, An Introduction to the Intel Family of Microprocessors, Pearson, 1999.
3.	Barry B. Brey, The Intel Microprocessors, (7/e), Eastern Economy Edition , 2006.

URLs:

1.	
2.	
3.	

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1.	Evolution of Microprocessor
2.	Typical organization of a microcomputer system and functions of its various blocks
3.	Architecture of a Microprocessor (With reference to 8085 microprocessor)
4.	Concept of Bus, bus organization of 8085,Functional block diagram of 8085 and function of each block
5.	Register structure of 8085
6.	Pin details of 8085 and related signals
7.	Concept of memory mapping,
8.	Instruction Timing and Cycles (Basic Introduction)
9.	Brief idea of machine and assembly languages, Machines and Mnemonic codes
10.	Instruction format and Addressing modes
11.	Instruction set, Data transfer group, Arithmetic Group, Logic Group
12.	Stack, I/O and Machine Control Group
13.	Programming exercises in assembly language (with the help of examples)
14.	Various hardware and software interrupts of 8085
15.	8086 Microprocessor - Architecture and signals, Memory Segmentation
16.	Register structure of 8086
17.	Pin details of 8086 and related signals
18.	Minimum and maximum mode of operation
19.	Comparison of 8086 and 8088
20.	8086 Addressing Modes
21.	8086 Instruction set, Data transfer group
22.	Arithmetic Group, Logical Group
23.	String Instructions
24.	Branching and Machine Control Operations
25.	Assembly Language Programming
26.	Assembly Language Programming
27.	Timing Diagram, Bus Timing
28.	Interfacing Memory with 8086
29.	General purpose interfacing devices
30.	PPI 8255 - Detailed study, Architecture, Control word format and modes of

	operation
31.	USART 8251- Detailed study, Architecture, Control word format and modes of operation
32.	DMA 8257- Detailed study, Architecture, Control word format and modes of operation
33.	PIC 8259- Detailed study, Architecture, Control word format and modes of operation
34.	TIMER 8253/54- Detailed study, Architecture, Control word format and modes of operation
35.	Salient features of advanced microprocessors: 80286,386,486, Pentium
36.	CISC and RISC processors
37.	Introduction to ARM processor
38.	Microcontrollers - Types of Microcontrollers, Criteria for selecting a microcontroller
39.	Microcontroller – 8051, Architecture,
40.	Microcontroller – 8051, Register Organization, Memory and I/O addressing
41.	8051 Addressing Modes
42.	Different types of instructions and Instruction Set
43.	Simple Programs

Name of Program	B.Tech	**Semester** IV	**Year** II
Name of Course	Electromagnetic Fields and Transmission Lines		
Course Code	ECE 224		
Core / Elective / Other	Core		

Prerequisite:

1.	Vector Algebra
2.	Matrix operations
3.	Differentiation and Integration

Course Outcomes:

1.	Understanding applications of Vector calculus and matrix operations in EM fields
2.	To understand basics of the three orthogonal coordinate systems namely Cartesian, Cylindrical and Spherical and learning transformation of a point and a vector from one coordinate system to another coordinate system.
3.	To learn vector calculus such as Gradient, Divergence, Curl and Laplacian.
4.	understanding of basics of Electrostatics and Magnetostatics
5.	Capable to analyze and understand EM wave propagation through various types of mediums and boundary conditions.

Description of Contents in brief:

1.	Review of vector algebra, Cartesian, Cylindrical and Spherical Coordinate Systems (CS) and transformation of a point and a vector of one CS to another CS. Del operator, Gradient, Divergence, Curl, Laplacian and Poission's equation.
2.	Electrostatic field due to uniform charge distribution over line, surface and volume, Gauss Law and applications.
3.	Magnetostatic field Ampere's law and applications. Maxwell's equations for static and time varying field, boundary conditions for conductor and dielectric
4.	Wave equations for free space, uniform plane waves, linear, elliptical and circular polarization, wave equations for conducting medium, wave propagation in conductors and dielectric, depth of penetration, reflection and refraction of plane waves by conductor and dielectric, Poynting vector and flow of power,
5.	Introduction and analysis of Transmission Line, Physical Interpretation of Voltage & Current Solution, Impedance Characteristics of Loss less Transmission Line.

List of Text Books:

1.	Elements of Electromagnetics Mathew N.O. Sadiku
2.	Introduction to Electrodynamics David J. Griffithe
3.	Network and Transmission Lines G.K.Mithal, Khanna publications

List of Reference Books:

1.	Engineering Electromagnetics W.H. Hayt
2.	Engineering Electromagnetics, McGraw Hill John D Kraus Engineering Electromagnetics, McGraw Hill John D Kraus

3.	Network and Transmission Lines J.D. Ryder, prentice hall of India
URLs:	
1.	https://nptel.ac.in/courses/117101056/
2.	https://swayam.gov.in/nd1_noc20_ee04

Lecture Plan (about 40-50 Lectures):

Lecture No.	Topic
1.	Review of vector algebra
2.	Cartesian, Cylindrical and Spherical Coordinate Systems (CS)
3.	Transformation of a point and a vector of one CS to another CS
4.	Del operator, Gradient,
5.	Divergence, Divergence Theorem
6.	Curl, Stoke's Theorem
7.	Laplacian and Poission's equation
8.	Electrostatic field due to uniform charge distribution over line
9.	Electrostatic field due to uniform
10.	Electrostatic field due to uniform surface charge
11.	Electrostatic field due to uniform Volume charge distribution
12.	Gauss Law and applications.
13.	Gauss Law and applications Continued
14.	Magnetostatic field Ampere's law and applications
15.	Magnetostatic field Ampere's law and applications continued
16.	Maxwell's equations for static and time varying field
17.	Maxwell's equations in frequency domain
18.	Boundary conditions for conductor and dielectric
19.	Boundary conditions for dielectric and another dielectric
20.	Boundary conditions for dielectric and Air
21.	Wave equations for free space
22.	Wave equations for free spacecontinued
23.	Uniform plane waves, linear
24.	Elliptical and circular polarization
25.	Wave equations for conducting medium
26.	Wave propagation in conductors
27.	Wave propagation dielectric
28.	Wave propagation from conductor to dielectric and vice versa
29.	Depth of penetration
30.	Standing waves and Standing wave ratio
31.	Standing waves and Standing wave ratiocontinued
32.	Reflection and refraction of plane waves
33.	Reflection and refraction of plane wavescontinued
34.	Poynting vector and flow of power
35.	Poynting vector and flow of power continued
36.	Introduction and analysis of Transmission Line
37.	Introduction and analysis of Transmission Line continued
38.	Physical Interpretation of Voltage & Current Solution
39.	Physical Interpretation of Voltage & Current Solutioncontinued
40.	Impedance Characteristics of Loss less Transmission Line

Name of Program	B.Tech.	**Semester** IV	**Year** II
Name of Course	Electronic Instrumentation and Measurement		
Course Code	ECE 225		
Core / Elective / Other	Core		

Prerequisite:	
1.	Signal and system
2.	Network Analysis
Course Outcomes:	
CO-1	Understand the fundamental concepts of Measurement and instrumentation.
CO-2	Understand the measurement of electrical quantities and non-electrical quantities.
CO-3	Understand the design and working of Signal generators, signal analyzers and display devices.
CO-4	The student will be able to understand the working principle of various instruments used in the labs.
CO-5	The student will able to understand the working of various transducers and their application.
Description of Contents in brief:	
1.	Block schematics of measuring systems, performance characteristics, Static characteristics, DC voltmetersand ammeter, AC voltmeters and current meters, ohmmeters, multimeters, meter protection,extension of range, digital voltmeters.
2.	Oscilloscopes: CRO Structure, applications, specifications, working.Special purpose oscilloscopes: Dual trace, dual beamCROs, sampling oscilloscopes, storage oscilloscopes, digital storage CROs, Lissajous figures,frequency measurement, phase measurement, CRO probes
3.	Measurements using bridges: Wheat stone bridge, Kelvin bridge, AC bridges, Maxwell, Hay, Schering, Wien, Anderson bridges, Wagner & ground connection.
4.	Transducers: Classification, strain gauges, force and displacement, transducers, resistance thermometers, hotwire anemometers, LVDT, thermocouples, synchros; Piezoelectric transducers, variable capacitance transducers.
5.	Signal Generators: AF and RF signal generators, sine and square wave generators, function generators arbitrary waveform generator, sweep frequency generators, video signal generators, and specifications. Signal Analyzers: AF, HF wave analyzers, heterodyne wave analyzers, harmonic distortion, spectrum analyzers, power analyzers.
List of Text Books:	
1.	Electronics Instrumentation & Measurement System A.K. Shawney
2.	Electronics Measurement and Instrumentation Kalsi, PHI
3.	Electronics Measurement and Instrumentation, W.D. Cooper, PHI.
List of Reference Books:	
1.	David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press, 1st Edition, 2007
2.	Doebelin, E.O., Measurement systems, McGraw Hill, Fourth edition

URLs:	
1.	https://nptel.ac.in/courses/108/105/108105153/
Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**
1.	Introduction to the subject, Types of Measurements
2.	Types of Instrument performance characteristics of Measurement systems
3.	Types of errors and their causesCombination of errors
4.	Voltmeter and Multi-range voltmeterLoading and temperature effect of voltmeter performance
5.	Ammeter and Multi-range AmmeterLoading and temperature effect of Ammeter performance
6.	Vector voltmeterVector impedance meter
	Measurement using bridge Networks
7.	D.C. bridgesA.C. bridges
8.	Measurement of inductance using A.C. bridges
9.	Measurement of capacitance using A.C. bridges
10.	Measurement of frequency using A.C. bridgesWagner's Earthing device
	Cathode ray Oscilloscope
11.	CRO basic function and working
12.	Types of CRO
13.	Special purpose oscilloscopes
14.	Measurement of different quantities using CRO
	Measurement of Non-Electrical Quantities
15.	Transducers and their classification
16.	Thermoelectric Transducer (RTD and Thermister)
17.	Thermoelectric Transducer (Thermocouple)
18.	Strain gauge
19.	LVDT
20.	Photo electric Transducer, Photo multiplier tube.
21.	Photo conductive and voltaic cell
22.	Nuclear radiation transducer
	Signal Generators and Analyzers
23.	Simple generator and function generator
24.	Sweep frequency generator
25.	Wave analyzer
26.	Spectrum analyzer
27.	Harmonic distortion analyzer
	Digital measurement
28.	Advantages of digital instruments over analog instruments
29.	Digital frequency meter
30.	Digital to analog convertors
31.	Ramp type digital voltmeter
32.	Integrating type digital voltmeter
33.	Successive approximation type digital voltmeter
	Display devices
34.	LED
35.	LCD
36.	Seven segment and 14 segment Display

Fifth Semester

Name of Program	B.Tech	**Semester** V	**Year**III
Name of Course	Data Structures and Algorithms		
Course Code	CS 352		
Core / Elective / Other	Core		

Prerequisite:

1.	One programming language (C,C++)
2.	Mathematics
3.	

Course Outcomes:

1.	Be familiar with the use of data structures as the foundational base for computer solutions to problems.
2.	Become introduced to and investigate the differing logical relationships among various data items.
3.	Understand the generic principles of computer programming as applied to sophisticated data structures.
4.	Comprehend alternative implementations using the differing logical relationships and appreciate the significance of choosing a particular logical relationship for implementation within real-world setting.

Description of Contents in brief:

1.	**Introduction:** Data Structure and Abstract data types, Organization of Arrays, Structures, Pointers, Recursion.
2.	**Stacks**: Stack Implementation and Applications, Prefix Postfix and Infix Conversion, Use of Stack in Recursion.
3.	**Queues**: Linear Queue and Circular Queue, Applications of Queue. **Linked Lists**: Type of Linked Lists, Implementation of Stack and Queue using Linked list.
4.	**Trees**: Tree Concept, Binary Tree and it's Representations, Applications of Binary Tree, Huffman Coding, Binary Search Tree.
5.	**Graphs**: Graph and it"s Representations, Algorithms on graph. **Sorting and Searching**: Fundamental Searching algorithms (Sequential Search, Binary Search etc) Fundamental Sorting Algorithms (Selection Sort, Bubble Sort, Insertion Sort etc).

List of Text Books:

1.	R. G. Dromey, "How to Solve it by Computer", Prentice-Hall of India.
2.	Data Structures by Schaums Series, TMH
3.	

List of Reference Books:	
1.	Fundamentals of Data Structures in C by Horowitz, Sahni and Anderson-Freed.
2.	M. A. Weiss, "Data Structures and Algorithm Analysis in C", 2nd ed, Pearson Education Asia.
3.	Y. Langsam, M. J. Augenstein and A. M. Tenenbaum, "Data Structures using C", Pearson Education Asia.

URLs:	
1.	https://nptel.ac.in/courses/106102064/
2.	https://nptel.ac.in/courses/106106127/
3.	https://nptel.ac.in/courses/106103069/

Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**
1	Introduction to Data Structure
2	Primitive data type, Abstract data type
3	Time Complexity
4	Space complexity
5	Introduction to C/C++, variables, constants, operators, loops
6	Arrays-one dimension, two dimension array
7	multi-dimension array, programs related to array
8	Functions, recursive function
9	Use of structure in Data structure
10	Concept of pointers
11	Linked list, operation on linked list, singly linked list
12	Circular linked list, doubly linked list
13	Linked list in Arrays, linked list vs Arrays
14	Concept of stack, Implementation of Stack
15	Representation of stacks through Arrays
16	Application of Stacks
17	Infix to prefix conversion
18	Postfix conversion
19	Concept of Queue
20	Implementation of linear Queue using Array
21	Queue as an Abstract data type
22	Circular Queue
23	Double-ended Queue
24	Priority Queue
25	Representation of stack and queue as linked list
26	Application of Queues
27	Concept of Trees, Introduction to Non-linear Data Structure
28	Types of trees, Binary Tree, properties and representation of Binary tree
29	Binary Search Tree
30	Binary tree traversal , Application of Binary Tree
31	AVL trees and its representation
32	Operations on AVL Trees
33	Searching and Sorting
34	Efficiency of sorting algorithm, bubble sort

35	selection sort, Quick sort
36	Insertion sort, Merge sort, Heap sort
37	Introduction to searching, Binary search, sequential search
38	Introduction to Graphs, sequential representation of graph
39	Linked representation of Graph
40	Traversal of Graph, Application of Graphs
41	Djkstras Routing Algorithm
42	Minimum Spanning Tree
43	Hashing. Hash tables. Hash functions. Some examples of hash functions
44	Double hashing
45	Bucket addressing

Name of Program	B.Tech.	**Semester V**	**Year** III

Name of Course	**Information Theory & Coding**
Course Code	ECE 311
Core / Elective / Other	**Core**

Prerequisite:	
1.	Basic exposure to linear algebra
2.	Probability theory
3.	A course in digital communications
Course Outcomes:	
1.	In this course we will explore maximum data rate at which we can transmit over a communication link and fundamental limit of data compression
2.	This course will introduce the error control codes – Low Density Parity Check codes and Polar codes - that have been proposed for 5G cellular communication systems.
3.	Implementation of decoders for codes.
4.	MATLAB simulation of various decoders.
Description of Contents in brief:	
1.	Definition of Information Measure and Entropy, extension of An Information source and Markov Source, adjoint of An information Source, Joint and Conditional Information Measure, properties of Joint and Conditional Information Measures and a Morkov Source, asymptotic properties of Entropy and Problem Solving in Entropy
2.	Block Code and its Properties,instantaneous Code and Its Properties,Kraft-Mcmillan Equality and Compact Codes, Shannon's First Theorem, Coding Strategies and Introduction to Huffman Coding, Huffman Coding and Proof of Its Optimality, Competitive Optimality of The Shannon Code,Non-Binary Huffman Code and Other Codes, Adaptive Huffman Coding ,Shannon-Fano-Elias Coding and Introduction to Arithmetic Coding, Arithmetic Coding
3.	Introduction to Information Channels, Equivocation and Mutual Information, Properties of Different Information Channels, Reduction of Information Channels, Properties of Mutual Information and Introduction to Channel Capacity, Calculation of Channel Capacity for Different Information Channels, Shannon's Second Theorem
4.	Differential Entropy and Evaluation of Mutual Information for Continuous Sources and Channels, Channel Capacity of A Band Limited Continuous Channel, Introduction to Rate-Distortion Theory, Definition and Properties of Rate-Distortion Functions, Calculation of Rate Distortion Functions, Computational Approach for Calculation of Rate-Distortion Functions
5.	Introdution to Quantization, Lloyd- Max Quantizer, Companded Quantization, Variable Length Coding and Problem Solving in QuantizerDesign,Vector Quantization, Transform Coding.
List of Text Books:	
1.	Digital Communication by Haykins Simon Wiley Publ.
2.	Modern analog and Digital Communication system, by B.P. Lathi

3.	Error control Coding: Theory and Application, by Shu Lin and Cosstlello,PHI
List of Reference Books:	
1.	R. Bose, Information theory, coding and cryptography, McGrawHill
2.	Herbert Taub and Donald Scihiling ,"Principles of Communication Systems",McGraw Hill Publication
3.	R P Singh and S D Sapre "Communication systems", TMH
URLs:	
1.	https://nptel.ac.in/courses/117101053/
2.	https://nptel.ac.in/courses/108102117/
3.	https://nptel.ac.in/courses/117/104/117104129/
Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**
1	Introduction to Information Theory and Coding
2	Definition of Information Measure and Entropy
3	Extention of An Information Source and Markov Source
4	Adjoint of An Information Source, Joint and Conditional Information Measure
5	Properties of Joint and Conditional Information Measures and A Morkov Source
6	Asymptotic Properties of Entropy and Problem Solving in Entropy
7	Block Code and its Properties
8	Instantaneous Code and Its Properties
9	Kraft-Mcmillan Equality and Compact Codes
10	Shannon's First Theorem
11	Coding Strategies and Introduction to Huffman Coding
12	Huffman Coding and Proof of Its Optamality
13	Competitive Optamality of The Shannon Code
14	Non-Binary Huffman Code and Other Codes
15	Adaptive Huffman Coding Part-I
16	Adaptive Huffman Coding Part-II
17	Shannon-Fano-Elias Coding and Introduction to Arithmetic Coding
18	Arithmetic Coding Part-I
19	Arithmetic Coding Part-II
20	Introdution to Information Channels
21	Equivocation and Mutual Information
22	Properties of Different Information Channels
23	Reduction of Information Channels
24	Properties of Mutual Information and Introdution to Channel Capacity
25	Calculation of Channel Capacity for Different Information Channels
26	Shannon's Second Theorem
27	Discussion On Error Free Communication Over Noisy Channel
28	Error Free Communication Over A Binary Symmetric Channel and Introdution to Continous Sources and Channels
29	Differential Entropy and Evaluation of Mutual Information for Continuous Sources and Channels
30	Channel Capacity of A BandLimited Continuous Channel

31	Introduction to Rate-Distortion Theory
32	Definition and Properties of Rate-Distortion Functions
33	Calculation of Rate-Distortion Functions
34	Computational Approach for Calculation of Rate-Distortion Functions
35	Introdution to Quantization
36	Lloyd-Max Quantizer
37	Companded Quantization
38	Variable Length Coding and Problem Solving in Quantizer Design
39	Vector Quantization
40	Transform Coding

Name of Program	B.Tech	**Semester** V	**Year** II
Name of Course	Control systems		
Course Code	ECE 312		
Core / Elective / Other	Core		

Prerequisite:

1.	Signal and system
2.	Network Analysis
3.	

Course Outcomes:

CO-1	The student will be able to make a comparative analysis of various techniques in modeling control systems.
CO-2	The student will be able to assess the characteristics of control systems using various tools and to design appropriate compensation technique.
CO-3	The student will be able to examine the stability of control systems using various techniques.
CO-4	The student will be able to analyze the dynamic behaviour of control systems using state space model.
CO-5	The student will be able to understand the working principle of PI,PD and PID controllers.
CO-6	The student will able to understand the working principle of sampled data systems.

Description of Contents in brief:

1.	Terminology and Basic Structure-Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchronous -Multivariable control system
2.	Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI,PID control systems
3.	Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot — Polar Plot-Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation
4.	Concept of stability-Bounded — Input Bounded — Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.
5.	State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback.

List of Text Books:

1.	Electronics Instrumentation & Measurement System A.K. Shawney
2.	Electronics Measurement and Instrumentation Kalsi, PHI
3.	Control System Engineering Nagrath& Gopal
4.	Linear Control System B.S.Manke

List of Reference Books:

1.	Modern Control System R.C. Dorf & R.N. Bishop
2.	Modern Control Engineering K. Ogata
3.	Automatic Control System By B.C. KUO

URLs:

1.	https://www.youtube.com/watch?v=vVFDm__CdQw
2.	https://www.youtube.com/watch?v=7LZSjgZz-Qw&list=PLxn52v8fxX5l5tGzU1NAxRDkgqxK0k5UZ
3.	https://nptel.ac.in/courses/107106081/

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1	Concepts of Control Systems
2	classification of control system and Example of control systems
3	Mathematical Modeling of servomechanism
4	Block diagram reduction technique
5	Signal flow graph algebra
6	Tutorials
7	Standard test signals
8	Time response of first order
9	Time response of second order
10	steady state error and Error coefficients
11	Proportional control , Derivative control , Integral control
12	PID control
13	Effect of addition of pole and zero
14	Concept of stability
15	Routh hurwitz criterion
16	problems
17	Gain margin
18	Phase margin
19	The root locus concept
20	construction of root loci
21	Tutorial

22	Tutorial
23	Bode plots
24	Tutorial
25	Tutorial
26	GM and PM -Stability Analysis from Bode Plots
27	Numericals
28	Nyquist Plots
29	Nyquist Stability Criterion
30	Assessment of relative stability
31	Compensation techniques with bode plot.
32	Compensation techniques with root locus.
33	State equations
34	Concepts of Controllability
35	Concepts of Observability
36	Digital control design using state feedback.
37	Design problems on lag compensation
38	Design problems on lead compensation
39	Design problems onlag-lead compensation
40	tutorial

Name of Program	B.TECH (ECE)	**Semester** V	**Year** III

Name of Course	Communication Systems
Course Code	ECE 313
Core / Elective / Other	Core

Prerequisite:	
1.	Signals and Systems
2.	
3.	

Course Outcomes:	
1.	Understand the concepts of analog modulation and demodulation techniques
2.	Learn the function of radio transmitters and receivers and familiarize with noise performance of various receivers
3.	Understand various digital modulation schemes and matched filter receiver
4.	Understand and analyze various digital pass band data transmission schemes

Description of Contents in brief:	
1.	Review of signals and systems, Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems.
2.	Amplitude modulation - Generation of Amplitude Modulation, Non-linear Modulation – Square law Modulator, Product Modulator, Switching Modulator, Demodulation of Amplitude Modulation – Envelope Detector, Coherent Detector, VSB, Performance comparison of various Amplitude Modulation Systems. Radio Receiver - Tuned Radio Frequency (TRF) Receiver, Superheterodyne Receiver. Noise in amplitude modulation system.
3.	Angle modulation - Frequency Modulation, Generation of NBFM, WBFM, Transmission BW of FM Signal, Phase Modulation. Relationship between PM & FM, Comparison, Generation of FM Direct Method, Indirect method, Demodulation of FM - FM Discriminators. Noise in Frequency modulation systems.
4.	Digital communications: PCM, DPCM, Delta modulation. Noise considerations in PCM. Time Division multiplexing, Digital Multiplexers.
5.	Digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation.

List of Text Books:	
1.	B.P.Lathi and Z. Ding, “Modern Digital and Analog Communication Systems,4Ed.”, Oxford,2011.
2.	HaykinS.,"Communications Systems", John Wiley and Sons, 2001.
3.	Taub H. and Schilling D.L., "Principles of Communication Systems”, Tata McGraw Hill, 2001.

List of Reference Books:	
1.	Proakis J. G. and Salehi M., "Communication Systems Engineering”, Pearson Education, 2002.
2.	Dennis Reddy & John Coolen, “Electronic Communications”, 4th Edition, Prentice Hall, 2008.

3.	Simon Haykin and Michael Moher, "Communication Systems," 5th edition, John Wiley & Sons, 2013
URLs:	
1.	
2.	
3.	

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1.	Review of signals and systems
2.	Random variables and Random processes
3.	Autocorrelation and power spectral density
4.	Properties of white noise
5.	Filtering of random signals through LTI systems
6.	Block diagram of Communication System
7.	Amplitude modulation generation methods
8.	DSB-SC, SSB, VSB
9.	Demodulation of Amplitude Modulation – Envelope Detector, Coherent Detector
10.	TRF Receiver
11.	Superheterodyne Receiver
12.	Noise in amplitude modulation system
13.	Introduction to Angle modulation
14.	Frequency Modulation, Generation of NBFM, WBFM
15.	Direct and Indirect method of FM generation
16.	Phase Modulation
17.	Demodulation of FM - FM Discriminators
18.	Superheterodyne Receiver
19.	Noise in Frequency modulation systems
20.	Introduction to Digital communications
21.	PAM, PPM, PWM
22.	PCM- Sampling, Quantization, Encoding
23.	Quantization error, SN_qR, BW calculation
24.	Companding
25.	DPCM, Delta Modulation
26.	Delta Modulation, ADM
27.	Time Division multiplexing
28.	Digital Multiplexers
29.	Digital modulation schemes
30.	Amplitude, phase and frequency shift keying (ASK, PSK, FSK)
31.	QPSK,M-ary PSK
32.	DPSK-transmitter and receiver implementations
33.	MAP and ML decoding
34.	Optimum Receiver and matched filter
35.	Matched filter receiver
36.	Probability of error calculation

37.	Signal Space Representation, Orthogonality, Orthonormality, Representation of Signals In Terms of Orthonormal Basis Functions Signal Space Representation, Orthogonality, Orthonormality, Representation of Signals In Terms of Orthonormal Basis Functions Signal Space Representation, Orthogonality, Orthonormality, Representation of Signals In Terms of Orthonormal Basis Functions Signal Space Representation, Orthogonality, Orthonormality,
38.	Representation of Signals in Terms of Orthonormal Basis Functions
39.	Constellation Diagram for different signaling schemes
40.	Calculation of BW and Energy efficiency
41.	Calculation of bandwidth, SNR and BER for digital modulation

Name of Program	**B. Tech**	**Semester** V	**Year** III

Name of Course	**VLSI Design**
Course Code	ECE 314
Core / Elective / Other	**Core**

Prerequisite:	
1.	The students are well versed with the fundamentals Basic electronics.
2.	The students are well versed with the fundamentalsDigital electronics.
3.	The students are well versed with the fundamentals Micro-electronics.

Course Outcomes:	
1.	Demonstrate a clear understanding of CMOS fabrication flow and technology scaling.
2.	Students will be able to design MOSFET based logic circuit
3.	Students will be able to draw layout of a given logic circuit
4.	Student will be able to realize logic circuits with different design styles
5.	Student will be able to demonstrate an understanding of working principles of clocking and testing of circuits.

Description of Contents in brief:	
1.	Introduction to MOS Technology - CMOS fabrication. Basic Electrical Properties - NMOS Inverter, Zpu/Zpd ratio, CMOS Inverter, Regions of Operation. MOS Circuits and logic design: Switching logic, gate logic, Two/Three input NMOS, CMOS&BiCMOS, NAND & NOR gates, CMOS logic structures, clocking strategies. Introduction of VLSI Design Methodologies – Design Description domains. System design and methods - CMOS design methods, CMOS design options. Layout design rules and Stick diagrams. Introduction to VLSI Testing.

List of Text Books:	
1.	Basic VLSI Design Douglas A. Pucknell & Kamran Eshraghian.
2.	Principles of CMOS VLSI design Neil H.E. Weste& Kamran Eshraghian

List of Reference Books:	
1.	CMOS VLSI Design Harris, Weste, Banerjee

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1.	Review of IC manufacturing.
2.	N-well and p-well process.
3.	CMOS Twin - Tub process.
4.	Integrated Circuit – An Overview.
5.	Introduction to MOS Technology.
6.	Basic Properties of MOS Circuits.
7.	Basic Electrical Properties - NMOS Inverter
8.	Pull-up to Pull-down ratio of nMOS invertor.
9.	Alternatives forms of Pull-up.
10.	CMOS Inverter
11.	Regions of Operation

12.	Power Dissipation in CMOS circuits
13.	Charge sharing and Latch-up problem.
14.	Physical design of logic gates- Switches and Transmission gates.
15.	CMOS Circuit and Logic design.
16.	BiCMOS invertor
17.	BiCMOSNAND& NOR gates
18.	CMOS Logic Structures- Pseudo-nMOS logic.
19.	Dynamic CMOS logic.
20.	CMOS Domino logic.
21.	NP Domino logic.
22.	Clocking Strategies.
23.	Clock skew.
24.	Timing issues.
25.	Setup and Hold Time
26.	Static and Dynamic timing analysis.
27.	CMOS Design Methods.
28.	Behavioral Synthesis.
29.	Logic optimization.
30.	Design-Capture Tools.
31.	Chip Composition.
32.	Design Verification Tools.
33.	Network Isomorphism.
34.	Layout design rules
35.	Stick diagrams
36.	CMOS Testing.
37.	Manufacturing test principles - Fault Modeling, Gate level Testing.
38.	Controllability and Observability
39.	Ad Hoc Testable Design Techniques.
40.	Scan-Based Techniques.
41.	BIST Techniques.
42.	I_{DDQ} Test.

Sixth Semester

Name of Program	**B. Tech**	**Semester VI**	**Year III Year**
Name of Course	ENGINEERING MANAGEMENT		
Course Code	ME 351		
Core / Elective / Other	Core (for all the branches)		
Prerequisite if any:			
1.	None		
Course Outcomes: Students shall develop			
1.	Understanding the relevance and importance of Management Practices for Engineers.		
2.	Knowledge and Practices on the interdisciplinary course content that combines an engineering focus with core business and management knowledge.		
3.	Ability to understand various methods of analysis and decision making related to operations, human resources, finances and marketing management.		
Description of Contents in brief:			
Unit 1.	Principles/Functions of Management, Measure of Productivity and ways to enhance Productivity. Management challenges for Engineers.		
Unit 2.	Operations Management and its scope, Production Systems, Facility Location, Facility Planning & Plant Layouts.		
Unit 3.	Industrial Design, Product Design, Product / Project Life Cycle, Quality Control and Quality Management, Forecasting Methods, Introduction to Supply Chain Management.		
Unit 4.	Material Management – Purchasing, Inventory & JIT Systems, Material Resource Planning, Scheduling, Project Management, PERT and CPM, Project Crashing.		
Unit 5.	Introduction to Financial Management, Financial Statements and Analysis, Operations Decision making - Break Even Analysis & Decision Trees		
Unit 6	Fundamentals of Marketing Management, Organizational Behavior and Leadership, Strategic Management, Statutory and Legal Issues.		
List of Text Books:			
1.	Modern production/operations management by Buffa: Wiley India		
2.	Marketing Management by Kotler; PHI		
3.	Operations Management by Russel & Taylor; Wiley		
List of Reference Books:			
1.	Handbook of Industrial Engineering: Technology and Operations Management by GavrielSalvendy; Wiley publication		
2.	Operations management by Krajewski; pearson		
3.	Industrial Engineering by Shankar Ravi; Galgotia Publication		
4.	Financial Management by I M Pandey; Vikas		
5.	Strategic Management by Pearce, Robinson and Mital; Mc Graw Hill Education		
URLs:			
1.	https://nptel.ac.in/courses/112/107/112107238/		
2.	https://nptel.ac.in/courses/110/107/110107144/		
Lecture Plan (about 40-50 Lectures):			

***Lecture No.**	**Topic**	**Remarks**
1.	Introduction to the course and its scope	
2.	Principles and Functions of Management	
3.	Principles and Functions of Management	
4.	Productivity and its Measures	
5.	Productivity and its Measures	
6.	Ways to enhance Productivity	
7.	Management Challenges for Engineers	
8.	Operations Management and Its Scope	

9.	Production Systems	
10.	Plant Location and Site Selection – An Introduction	
11.	Factors affecting Plant Location	
12.	Plant Layout, Types and characteristics of a good plant layout	
13.	Procedure and Methods of Plant Layout	
14.	Procedure and Methods of Plant Layout	
15.	Factors affecting Plant Layout	
16.	Installation and evaluation of Plant Layout	
17.	Industrial Design& Morphology of Design	
18.	Product Life Cycle	
19.	Product Design and Approaches to Product Design	
20.	Product Design and Approaches to Product Design	
21.	Product Design and Approaches to Product Design	
22.	Introduction to Forecasting Methods	
23.	Forecasting Models	
24.	Quality Control and Quality Management - Introduction	
25.	Quality Circle and Total Quality Management	
26.	Supply Chain Management	
27.	Characteristics of Supply Chain Management	
28.	Application of SCM	
29.	Material Management – Purchasing	
30.	Inventory Models	
31.	Inventory Models	
32.	JIT Systems	
33.	Material Resource Planning	
34.	Introduction to Project Management– Planning, Scheduling & Controlling	
35.	CPM	
36.	PERT	
37.	Project Crashing	
38.	Financial management – Introduction & Its interface with other functions of Management	
39.	Financial Planning, Estimation of Financial Requirements of a Project	
40.	Working Capital Management	
41.	Break Even Analysis, Risk Analysis and Decision Trees	
42.	Concept and Functions of Marketing Management	
43.	Marketing Process – Marketing Mix	
44.	Marketing Environment and Marketing Research	
45.	Consumer & Business Buyer Behavior	
46.	Segmentation & Targeting	
47.	Distribution and Pricing	
48.	Organizational Behavior and Leadership	
49.	Organizational Behavior and LeadershipContd	
50.	Strategic Management	
51.	Statutory and Legal Issues.	

Name of Program	**B.Tech** ECE	**Semester** VI	**Year** III

Name of Course	Digital Image Processing
Course Code	ECE 321
Core / Elective / Other	Core

Prerequisite:

1.	Digital Signal Processing
2.	Probability and Statistics
3.	

Course Outcomes:

1.	Analyze general terminology of digital image processing.
2.	Examine various types of images, intensity transformations and spatial filtering
3.	Evaluate the methodologies for image segmentation, restoration etc.
4.	Implement image process and analysis algorithms
5.	Apply image processing algorithms in practical applications

Description of Contents in brief:

1.	Digital Image Fundamentals
2.	Image Enhancement
3.	Morphological operations
4.	Image Segmentation
5.	Image Compression

List of Text Books:

1.	R.C.Gonzalas and R.E.Woods, Digital Image Processing, Prentice Hall, 3rd Ed

List of Reference Books:

1.	A.K.Jain, Fundamentals of Digital Image Processing, Prentice Hall.
2.	S.Sridhar, Digital Image Processing, Oxford University Press.

URLs:

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1	Fundamental steps in DIP, Components of digital image processing,
2	Elements of visual perception, Structure of the human eye, Image formation in the eye, Brightness adaptation and discrimination, light, Image sensing and acquisition,
3	Image formation model, definition and some properties of two dimensional system,

4	Discrete 2D convolution, 2D discrete Fourier transform and its properties,
5	Sampling and quantization of images, Two dimensional sampling theory, representation of digital image,
6	Some basic relationships between pixels.
7	Image Interpolation
8	Image Interpolation Contd...
9	Basics of Image Enhancement
10	Gray Level Transformations,
11	Piecewise linear transformation, Histogram Processing,
12	Histogram equalization
13	Enhancement Using Arithmetic/Logic Operations. Basics of Spatial Filtering, Smoothing and Sharpening Spatial Filters,
14	Use of first order and second order derivative in enhancement.
15	Two dimensional Fourier Transform, properties of frequency domain, correspondence between filtering in spatial and frequency domain,
16	Smoothing and Sharpening frequency domain filters, Homomorphic Filtering.
17	Fundamentals of Image Compression, Image compression models,
18	concepts of Information Theory, Fundamental coding theorems, Estimation of entropy,
19	Variable length coding,
20	Huffman coding, Near optimal variable length coding,
21	Near optimal variable length coding, Arithmetic coding,
22	Constant area coding, run length coding,
23	Image compression standards (JPEG, JPEG2000).
24	Morphological Image Processing fundamentals
25	Introduction, Logic Operations involving Binary Images, Dilation and Erosion
26	Opening and Closing, Morphological Algorithms, Hit or Miss Transformation
27	Extraction of Connected component, connected component labeling
28	Boundary Extraction, Region Filling,
29	Convex Hull, Thinning, Thickening
30	Image Segmentation Fundamentals
31	Detection of Discontinuities (point, line edge),
32	Edge Linking and Boundary Detection,
33	Edge Linking and Boundary Detection contd…
34	Basic global Thresholding,
35	Adaptive Thresholding,
36	Region-Based Segmentation, region growing,
37	Region splitting and merging.
38	Object Representation and Description fundamentals
39	Chain code, polygon approximation, signatures
40	Boundary Segmentation, Skeleton, Shape Number, Fourier Descriptor, Statistical moment

Name of Program	B.Tech	**Semester** VI	**Year** III

Name of Course	Optical Communication
Course Code	ECE 322
Core / Elective / Other	Core

Prerequisite:

1.	EM Fields
2.	
3.	

Course Outcomes:

CO-1	Demonstrate an understanding of optical fiber communication link, structure, propagation and transmission properties of an optical fiber.
CO-2	Estimate the losses and analyze the propagation characteristics of an optical signal in different types of fibers
CO-3	Describe the principles of optical sources and power launching -coupling methods
CO-4	Compare the characteristics of fiber optic receivers
CO-5	Design a fiber optic link based on budgets and assess the different techniques to improve the capacity of the system

Description of Contents in brief:

1.	Overview of Optical Fiber Communication: Basic concepts, laws and definition, mode theoryanalysis for optical communication, optical fiber modes and configuration, wave propagation inoptical fiber, operating wavelength, single mode and multimode fibers, V–numbers, mode fielddiameter, numerical aperture, refractive index profiles.
2.	Losses in optical fibers .Dispersion inoptical waveguides, group delay, Design optimization of advance single mode fibers anddispersion compensating fibre. Trends in fiber design.
3.	Optical Sources & Optical Detectors:Structure, principle and their characteristics, BER. Overview of analog and digital optical link,
4.	Point to point link system consideration: Link power budget and risc time analysis .Line coding
5.	Fiber Optic Networks, optical amplifiers, WDM & DWDM Optical System, Optical Networks – SONET/SDH, Optical Layer, future of fiber–optic network.

List of Text Books:

1.	Optical Fiber Communication G. Keiser

2.	Optical Fiber Communication John M Senior
3.	Introduction to fiber Optics A. Ghatak& K. Tyagrajan
4.	Fiber optic communication system by Govind P. Agrawal

List of Reference Books:

1.	Optical Fiber Communication P. Chakrabarti
2.	Fiber optic communication system by Shiva Kumar
3.	Fiber optic communication system bypierrelecoy

URLs:

1.	https://nptel.ac.in/courses/117101054/
2.	https://nptel.ac.in/courses/117101002/
3.	https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/115107095/lec40.pdf

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1.	Overview of Optical Fiber Communication
2.	Basic concepts of optical fiber and Light
3	Basic laws and definitions, Ray model
4	Mode theoryanalysis for optical communication, Wave model
5	Different modes in fibers like LP modes
6	Tutorials
7	Tutorials
8	Wave propagation inoptical fiber, operating wavelength, single mode and multimode fibers, V–numbers
9	Mode fielddiameter, numerical aperture, refractive index profiles.
10	Mini test
11	Signal Losses in optical fibers
12	Scattering loss, Radiation loss
13	Dispersion inoptical waveguides, Intermodal and intramodal Dispersion
14	Design optimization of advance single mode fibers anddispersioncompensatingfibre ,
15	Dispersion Flattern fiber and dispersion shifted fiber.
16	Optical sources: LED as a course,
17	Energy band theory ,Characteristics of optical sources.
18	Internal and external Efficiency of the LED, Spectral Bandwidth
19	spontaneous and stimulated emission
20	LASER
21	TUTORIAL
22	TUTORIAL
23	Optical Detectors:Structure, principle and their characteristics

24	Photo diodes
25	Pin diodes
26	Receiver Sensitivity
27	TUTORIAL
28	Fiber optic Link Design
29	Link power budget
30	rise time analysis
31	Line coding
32	Wavelength division Multipexing
33	Optical amplifiers
34	Optical Amplifier
35	Fiber Optic Networks
36	DWDM Optical System
37	Optical Layer
38	Optical Networks –SONET/SDH
39	Future of fiber–optic network.
40	Tutorials

Name of Program	B. Tech.	**Semester** VI	**Year** III

Name of Course	Microwave Engineering
Course Code	ECE 323
Core / Elective / Other	Core

Prerequisite:

1.	Electromagnetic Fields

Course Outcomes:

1.	Design impedance matching network for transmission line
2.	Understand and Analyze parameters and characteristics of the various waveguide components.
3.	Analyze microwave power supplies for the transmission of the EM waves.
4	Acquire knowledge about the measurements to be done at microwaves

Description of Contents in brief:

1.	Maxwell's and Helmholtz's equations, wave solutions, TEM, TE and TM wave propagation modes, and account for the relevant propagation modes for transmission lines
2.	Calculate the characteristic parameters of a rectangular waveguide
3.	Analysis of Microwave power supplies
4.	Scattering parameter analysis
5.	Practical oriented study and analysis for micrometer measurements

List of Text Books:

1.	Microwave Devices and Circuits, Samuel Y. Liao, PHI
2.	Microwave Engineering, David M.Pozar, Wiley India,
3.	Microwave and Radar Engineering ,M. Kulkarni, Umesh Publications

List of Reference Books:

1.	Microwave Principles-Herbert J.Reich, J.G.Skalnik, P.F.Ordung and H.L. Krauss, CBS Publishers
2.	Microwave Engineering Passive Circuits-Peter A.Rizzi, PHI
3.	Electronic and Radio Engineering-F.E Terman, McGraw-Hill

URLs:

1.	http://www.microwaves101.com/downloads.cfm
2.	http://ieeexplore.ieee.org/xpl
3.	http://www.ycars.org/EFRA

Lecture Plan (about 40-50 Lectures):	
Lecture No.	
1	Characteristic, features and applications of microwaves
2	Rectangular waveguide, TE, mode propogation
3	TM and TEM mode propogation
4	Rectangular waveguide power flow and attenuation in different modes
5	Circular waveguide
6	Numericals
7	Scattering parameters for two port and n port networks
8	Republic Day Holiday
9	Properties of scattering parameter lossless and reciprocal properties
10	Scattering parameter for E and H plane tee
11	Scattering parameter for H plane tee
12	Scattering parameter for magic tee
13	Scattering parameter for two hole directional coupler
14	Study of circulator and isolators
15	Numericals on scattering matrix and microwave components
16	Two cavity klystron amplifier
17	Two cavity klystron amplifier calculation efficiency and applications
18	Two cavity klystron amplifier velocity modulation derivation
19	Two cavity klystron amplifier efficiency derivation
20	Reflex klystron
21	Reflex klystron velocity modulation
22	Reflex klystron numericals
23	Cylindrical magnetron oscillator
24	Linear magnetron oscillator
25	Magnetron oscillator
26	Numericals on magnetron
27	Tunnel diodes
28	Gunn effect
29	Gunn Diode numericals
30	Avalanche effect
31	PIN diodes and applications
32	Planer transmission lines such as stripline
33	Microstrip line
34	Slotline
35	Technology of hybrid MICs
36	Advantages of MICs
37	VSWR measurement
38	Microwave power measurement
39	Microwave power measurement
40	Frequency measurement
41	Numericals on microwave measurement

Seventh Semester

Name of Program	B.TECH	Semester-VII	Year :IV
Name of Course	**Engineering Economics and IPR**		
Course Code	**HUM 451**		
Core / Elective / Other	Core (Semester 7th ECE)		

Prerequisite:	
1.	Theoretical underpinning of the concepts related to Economics is crucial.
2.	Technical knowledge and basic understanding of IPR laws is important.

Course Outcomes:	
1.	Students would be in a position to link the concepts of Economics and Engineering
2.	Understanding the production and related it with cash flow and payments
3.	Students will understand the benefits of IPR
4.	Understanding of Indian laws and acts regarding IPR

Description of Contents in Brief:

1.Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis – V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

2.Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

3. Make or buy decision, Value engineering – Function, aims, and Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor – Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

4. Basic concepts, characteristics and nature of Intellectual Property Right, IPR and Economic Development, major international instrument relating to the protection of IP. Meaning, Criteria for obtaining patents, Non Patentable inventions, procedure for registration, term of Patent, Rights of patentee, basic concept of compulsory license and government use of patent, infringement of patents and remedies in case of infringement, Relevant Sections.

5. Meaning of mark, trademark, and categories of trademark: Certification Mark and well known mark and Non-conventional marks, concepts of distinctiveness. Designs, GI and other forms of IP, Designs: meaning design protection, concept of original

	design, term of protection, relevant sections. Geographical Indication: meaning of GI, difference between GI and Trade Mark, Concept of Authorized Use, Homonymous GI, Relevant section,. Trade-secret: meaning, Criteria of Protection, relevant sections. Plant Variety, Protection and Farmer's Right: meaning, criteria of protection, relevant sections.
List of Text Books:	
1.	A. Koutsoyiannis "Modern Microeconomics'. Macmillan Education.
2.	Subbaram N.R. "Handbook of Indian Patent Law and Practice ", S. Viswanathan, Printers and Publishers Pvt. Ltd.,1998
3.	Stephen Ross and Randolph Westerfield and Jeffrey Jaffe and Bradford Jordan, "Corporate Finance', McGraw Hill.
List of Reference Books:	
1.	Chan Spark, "Contemporary Engineering Economics", Prentice Hall of India, 2011.
2.	Donald. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Egg. Press, Texas, 2010.
3.	Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 2011.
4.	Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012
5.	V.K. Ahuja , " Law related to Intellectual Property Rights". Publisher- Lexis-Nexi
6.	R. Radhakrishnan and S. Balasubramanian, "Intellectual Property Rights- Texts and Cases", publisher- Excel Books India.
7.	A. Koutsoyiannis "Modern Microeconomics'. Macmillan Education.
8.	Stephen Ross and Randolph Westerfield and Jeffrey Jaffe and Bradford Jordan, "Corporate Finance', McGraw Hill.
URLs:	
1.	https://nptel.ac.in/courses/109/104/109104125/
2.	https://nptel.ac.in/courses/110/107/110107144/
3.	http://www.ipindia.nic.in/
4.	https://nptel.ac.in/courses/109106100/

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1	Introduction to Economics and Flow in an economy
2	Law of supply and demand
3	Concept of Engineering Economics: Engineering efficiency
4	Economic efficiency
5	Scope of engineering economics
6	Element of costs: Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost
7	Break-even analysis: PV ratio
8	Elementary economic Analysis: Material selection for product Design selection for a product,

9	Process planning
10	Methods of comparison of alternatives: present worth method
11	Revenue dominated cash flow diagram
12	Future worth method (Revenue dominated cash flow diagram
13	Future worth method (Cost dominated cash flow diagram)
14	Annual equivalent method (Revenue dominated cash flow diagram)
15	Annual equivalent method (Cost dominated cash flow diagram)
16	Rate of return method
17	Make or buy decision, Value engineering: Function, aims, and Value engineering procedure
18	Interest formulae and their applications: Time value of money
19	Single payment compound amount factor
20	Single payment present worth factor
21	Equal payment series sinking fund factor
22	Equal payment series capital recovery factor
23	Equal payment series capital recovery factor
24	Uniform gradient series annual equivalent factor
25	Effective interest rate
	Intellectual Property Rights
1.	Introduction to IPR, its Importance, Need and Characteristics
2.	IPR and Economic Development
3.	Major International Instrument relating to the protection of IP
4.	Patents : Meaning &Criteria for obtaining Patents
5.	Procedure for Registration & Non Patentable inventions
6.	Term of Patent and Rights of patentee
7.	Basic concept of Compulsory License
8.	Government use of Patent
9.	Infringement of patents and Remedies in case of Infringement
10.	Relevant Sections of Patents
11.	Introduction to Mark and Trademark, Rights and Limitations of Trade Marks
12.	Categories of Trademark
13.	Certification Mark, Well known Marks and Non-Conventional Marks
14.	Concepts of Distinctiveness
15.	Introduction to Design: Its meaning and Registration process
16.	Meaning of Design Protection, Concept of Original Design, Term of Design
17.	Relevant Sections of Design
18.	Meaning of Geographical Indication and Difference between GI and Trade Mark
19.	Concept of Authorized Use
20.	Homonymous GI and Relevant section of GI
21.	Trade-secret: Meaning, Criteria of Protection, Relevant Sections of it.
22.	Plant Variety, Protection and Farmer's Right: Meaning, Criteria of Protection, Relevant Sections of it.
23.	Case Studies On – Patents (Basumati Rice, Turmeric, Neem, Etc.)

Name of Program	B.Tech	Semester VII	Year IV

Name of Course	Antenna and Wave propagation
Course Code	ECE 411
Core / Elective / Other	**core**

Prerequisite:	
1.	Vector Algebra
2.	Microwave Engineering
3.	Network Theorems

Course Outcomes:	
1.	CO1: Describe different multiplexing techniques.
2.	CO2: Express the concepts of different types of Antenna.
3.	CO3: Review the performance analysis of array Antenna.
4	CO4: Outline the microstrip patch antenna its architecture fabrication .
5	CO5: Analyze the Characteristics of a antenna for different network.

Description of Contents in brief:	
1.	Radiation, radiation field from current element antenna, radiation power and radiation resistance of short dipole and half dipole antenna.
2.	Field and phase of point sources, directivity and gain, direction and gain calculation of short and half wave antenna.
3.	Introduction to antenna as an aperture, effective length, resonant and traveling wave antenna for different wave length, antenna arrays of point sources, two element array
4.	end fire and broad side arrays, uniform linear arrays of N elements, patterns and principal of pattern multiplication, loop and helical antennas
5.	Yagi-Uda antenna, folded dipole, turn side, rhombic antenna. Huygens principle, Babinets principles & complimentary antenna, horn antennas, reflector antennas, log periodic antenna, slot antenna,
6.	polarization measurements, field strength measurement, Feeders for exciting resonant antenna, center fed and end fed, Ground wave propagation surface wave propagation, space wave propagation, reflection of wave by earths surface, reflection coefficient of vertically and horizontally polarized wave, space wave propagation, range of propagation, propagation beyond the line of sight, duct propagation
7.	Troposphere, scatter, field strength of tropospheric wave, ionosphere, virtual heights, critical frequencies, refractive index of ionized region, reflection and refraction of radio waves in ionosphere, influence of earths magnetic field, loss of energy in ionosphere, single hop and multiple hop transmissions, skip distance and maximum usable frequency (MUF).

List of Text Books:	
1.	Antennas, John D Krauss.
2.	2. Electromagnetic waves & Radiating Systems Jordan &Balman.
3.	Antenna & Wave Propagation K.D. Prasad.

List of Reference Books:	
1.	Antennas for all applications J D Kraus & Ronald J. Marhefka.
2.	Antenna theory C.A. Balanis.
3.	Antenna & Wave Propagation A.R. Harish & M. Sachidananda
URLs:	
1.	
2.	
3.	

Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**
1.	Radiation, radiation field from current element antenna
2.	----------do----------
3.	radiation power and radiation resistance of short dipole and half dipole antenna.
4.	----------do----------
5.	----------do----------
6	Field and phase of point sources, directivity and gain
7	----------do----------
8	----------do----------
9	direction and gain calculation of short and half wave antenna.
10	----------do----------
11	----------do----------
12	Introduction to antenna as an aperture, effective length, resonant and traveling wave antenna for different wave length,
13	----------do----------
14	----------do----------
15	----------do----------
16	antenna arrays of point sources, two element array
17	----------do----------
18	----------do----------
19	end fire and broad side arrays, uniform linear arrays of N elements
20	----------do----------
21	----------do----------
22	patterns and principal of pattern multiplication, loop and helical antennas
23	----------do----------
24	----------do----------
25	Yagi-Uda antenna, folded dipole, turn side, rhombic antenna. Huygens principle, Babinets principles & complimentary antenna,
26	----------do----------
27	----------do----------
28	----------do----------
29	horn antennas, reflector antennas, log periodic antenna, slot antenna,
30	----------do----------
31	----------do----------
32	----------do----------
33	polarization measurements, field strength measurement, Feeders for exciting

	resonant antenna, center fed and end fed, Ground wave propagation surface wave propagation, space wave propagation
34	----------do----------
35	----------do----------
36	----------do----------
37	reflection of wave by earths surface, reflection coefficient of vertically and horizontally polarized wave, space wave propagation
38	----------do----------
39	----------do----------
40	range of propagation, propagation beyond the line of sight, duct propagation
41	----------do----------
42	----------do----------
43	Troposphere, scatter, field strength of tropospheric wave, ionosphere, virtual heights, critical frequencies, refractive index of ionized region, reflection and refraction of radio waves in ionosphere
44	----------do----------
45	----------do----------
46	influence of earths magnetic field, loss of energy in ionosphere, single hop and multiple hop transmissions, skip distance and maximum usable frequency (MUF).
47	
48	----------do----------

LIST OF PROGRAMME ELECTIVES (GROUP A)
FOR 3rd YEAR

Name of Program	B. Tech	**Semester** **V/VI/VII/VIII**	**Year** 3rd/4th
Name of Course	VLSI Technology		
Course Code	ECE 351		
Core / Elective / Other	Elective		

Prerequisite:

1.	The students are well versed with the fundamentals of CMOS Design
2.	The students are well versed with the fundamentals layout rules.

Course Outcomes:

1.	Students will be able to understand mechanism of wafer preparation.
2.	Able to demonstrate working of various equipment's for fabrication techniques.
3.	Able to describe models of processes like epitaxy, diffusion, oxidation, etching etch & their dependence on various parameters.
4.	To provide knowledge of various material deposition techniques and electronic/VLSI device
5.	Understand the fabrication process of IC technology.

Description of Contents in brief:

Introduction to VLSI Technology: Classification of ICs, features of ICs , monolithic and hybrid ICs. Crystal Growth and Wafer Preparation: silicon crystal growth from the melt, crystal orientations, various defects in crystal, wafer preparation and wafer specifications. Epitaxy: Epitaxy and its concepts, growth kinetics of epitaxy, vapour phase epitaxy, molecular beam epitaxy. Oxidation: Theory of growth of silicon dioxide layer, calculation of SiO2 thickness and oxidation kinetics. Lithography- Photolithography and pattern transfer, optical and electron photolithography, X-ray and ion beam lithography. photoresist, types of photoresist. Etching- dry & wet etching. Diffusion Process- Diffusion in solids, diffusion equation and diffusion mechanisms. Ion implantation- Implantation equipments, high energy implantation, scattering phenomenon, range of implanted ions, implantation damage, annealing. Metallization- Metallization applications, metallization choices, physical vapour deposition, patterning & problems in metallization. Thick and thin film deposition. VLSI process integration – NMOS, CMOS, BJT. Assembly techniques, packing of VLSI devices.

List of Text Books:

1.	S.K. Ghandhi, "VLSI Fabrication Principles", John Wiley Inc.
2.	S.M. Sze,"VLSI Technology", McGraw Hill.

List of Reference Books:

1.	C.Y. Chang and S.M.Sze ,"ULSI Technology", McGraw Hill.

2.	James D. Plummer, “Silicon VLSI Technology: Fundamentals, Practice and Modeling”, Pearson Education.

Lecture Plan (about 40-50 Lectures):

Lecture No.	Topic
1.	Introduction to VLSI Technology: Classification of ICs.
2.	Features of ICs , monolithic and hybrid ICs.
3.	Refining of Silicon for Crystal Growth.
4.	Refining of Silicon for Crystal Growth contd...
5.	Wafer Preparation.
6.	Wafer Preparation contd...
7.	Crystal orientation.
8.	Defects in crystal.
9.	Epitaxy: Epitaxy and its concepts.
10.	Growth kinetics of epitaxy.
11.	Vapour phase epitaxy.
12.	Molecular beam epitaxy.
13.	Oxidation: Theory of growth of silicon dioxide layer.
14.	Calculation of SiO2 thickness.
15.	Oxidation kinetics.
16.	Lithography- Photolithography and pattern transfer.
17.	Optical photolithography
18.	Electron photolithography.
19.	X-ray and ion beam lithography.
20.	Types of photoresist.
21.	Etching- dry etching.
22.	Wet etching.
23.	Diffusion Process.
24.	Diffusion in solids.
25.	Diffusion equation and diffusion mechanisms.
26.	Diffusion equation and diffusion mechanismscontd....
27.	Implantation equipments.
28.	High energy implantation
29.	Scattering phenomenon
30.	Range theory of implanted ions.
31.	Implantation damage.
32.	Annealing.
33.	Metallization- Metallization applications
34.	Metallization choices.
35.	Physical vapour deposition.
36.	Patterning & problems in metallization.
37.	Thick film deposition.
38.	Thin film deposition.
39.	VLSI process integration – NMOS, CMOS, BJT.
40.	VLSI process integration –BJT.
41.	Assembly techniques.
42.	Packing of VLSI devices.

Name of Program	B.TECH	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	DIGITAL SYSTEM DESIGN		
Course Code	ECE 352		
Core / Elective / Other	**Elective**		

Prerequisite:		
1.	Digital Electronics	
Course Outcomes:		
1.	CO1	Ability to analysis & synthesis of synchronous and asynchronous sequential circuit design.
2.	CO 2	To understand the concepts of ASM for digital circuit design and implementation in practical applications.
3.	CO 3	Design digital system by using PLD's, PLA and PAL.
4	CO 4	Understand and explain the basic concepts of ASIC, CPLD and FPGA
5	CO 5	To impart an understanding of the basic concepts of digital system modeling
Description of Contents in brief:		
1.	Synchronous Sequential Logic Circuit Design: Introduction, Moore, Mealy and Mixed type Synchronous State Machines. Synchronous Counter Design, Hazards, Duality of sequential circuits, Different methods of minimization. Asynchronous Sequential logic design- Introduction, Primitive flow table and reduction, type of delays, Cycles and races, Excitation Map, Hazards, Essential hazards. Algorithmic State Machine, ASM charts, Design Procedure for ASMs. Fault Diagnosis in Sequential Circuits Introduction to programmable logic devices: PALs, PLDs, CPLDs and FPGAs. ASICs – Full custom, gate array based, standard cell based and Programmable ASICs, Antifuse, SRAM, EEPROM/ EPROM Technologies for Programmable ASICs.	
List of Text Books:		
1.		
List of Reference Books:		
1.	Donald D.Givone, "Digital Principles and Design", Tata McGraw-Hill	
2.	M.Morris Mano, "Digital Design", 3rd edition, Pearson Education	
3.	Charles H.Roth, Jr. "Fundamentals of Logic Design", 4th Edition, Jaico Publishing House	
URLs:		
1.		
2.		
3.		

Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**
1.	Review of sequential circuits, Mealy-Moore Circuits
2.	Analysis of clocked synchronous sequential networks
3.	Modeling of clocked synchronous sequential network behavior

4.	State table reduction, state assignment
5.	Design of clocked synchronous sequential networks
6.	Numerical
7.	Structure and operation of Asynchronous sequential network
8.	Races in Asynchronous sequential networks
9.	Primitive flow table, reduction of input restricted flow tables
10.	Problems on reduction of input restricted flow tables
11.	General procedure to flow table reduction
12.	State assignment problem and transition table
13.	Design of Asynchronous sequential networks
14.	Static, dynamic and essential hazards
15.	Problems based on hazards in combinational networks
16.	Problems on synchronous and asynchronous networks
17.	Algorithmic state machines
18.	Examples on ASM charts
19.	ASM transition and excitation tables
20.	ASM realization using gates and multiplexers
21.	ASM realization using PLA, PLD's and PROMs
22.	Problems on ASM charts
23.	Introduction to CPLD" $ FPGA"s.
24.	Digital system modeling:Behavioral, structural and physical domains.
25.	Fault modelling.
26.	Fault modelling
27.	ASICs-introduction and its types
28.	Anti-fuse Technologies for Programmable ASICs.
29.	SRAM Technologies for Programmable ASICs.
30.	EEPROM/EPROM Technologies for Programmable ASICs.

Name of Program	B. Tech.	**Semester V/VI/VII/VIII**	**Year** 3rd/4th
Name of Course	Design of Analog IC		
Course Code	ECE 353		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Knowledge of MOS Transistors
2.	
3.	
Course Outcomes:	
1.	Design and analysis of analog integrated circuits.
2.	Optimization in analog Integrated circuit design
3.	Numerical in the area of analog integrated circuits.
Description of Contents in brief:	
1.	Design CMOS analog circuits.
2.	Noise and distortion in analog circuits
3.	Analyze and Design of analog IC
4.	Small and large signal modeling and analysis. Different Single stage and Differential Amplifiers, Current Mirrors, operational amplifier, switch capacitor circuits
5.	Optimization and trade-offs involved in analog integrated circuit design
List of Text Books:	
1.	BehzadRazavi, “Design of Analog CMOS Integrated Circuits” ,McGrawHill
2.	Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer , “Analysis and Design of Analog Integrated Circuit”, John Wiley & Sons
3.	Willy Sansen, “Analog Design Essentials”, Springer
List of Reference Books:	
1.	David Johns & Ken Martin, Analog Integrated Circuit Design, Wiley-India,
2.	P. Allen & D. R. Holberg, CMOS Analog Circuit Design, Oxford Press,
3.	P. Gray, P. Hurst, S. Lewis, R. Meyer, Analysis and Design of Analog Integrated Circuits, Wiley-In
URLs:	
1.	www.analogic.com
2.	www.anylogic.com/resources/books/free-simulation-book-and-modeling-tutorials
3.	www.electronicshub.org/cmos-technology

Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**
1	Introduction to Analog circuit design
2	General Concepts of Analog IC Design
3	Performance parameter for analog design
4	Single-Stage Amplifier
5	Numerical on Common-Source Stage amplifier
6	Source Follower
7	Common-Gate Stage
8	Numerical on Common-Gate Stage amplifier
9	Cascode Stage and choice of Device Models
10	Single Ended and Differential Operation of Differential Amplifier
11	Basic Differential Pair
12	Common-Mode Response
13	Differential Pair with MOS Loads
14	Numerical on differential pair
15	Basic and Cascode Current Mirrors
16	Active Current Mirrors
17	General Consideration of Amplifiers
18	Common-Source Stage
19	Active load
20	Frequency response
21	Cascode Stage and Differential Pair
22	Characteristics and Types of Noise
23	Representation of Noise in Circuit
24	Noise in Single Stage Amplifier
25	Noise in Differential Pair and Noise Bandwidth
26	General Consideration and Feedback Topologies
27	Effect of Loading and Effect of Feedback on the Noise

28	Operational Amplifier Considerations and Types of Operational Amplifier
29	Compensation of Two-Stage Op Amps and Other Techniques
30	Gain Boosting
31	Common-Mode Feedback
32	Input Rate Limitation and Slew Rate
33	Power Supply Rejection and Noise in Op-Amp
34	Mutlipole System and Phase Margin
35	Frequency Consideration
36	Stability and frequency compenasation
37	Introduction to Switched-Capacitor Circuits
38	Sampling Techniques
39	Switched-Capacitors Amplifiers
40	Switched-Capacitor common mode feedback
41	Numerical on Switched-Capacitors Amplifiers

Name of Program	B TECH	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	Telecom switching system		
Course Code	ECE 354		
Core / Elective / Other	Elective		

Prerequisite:

1.	Computer Communication and Networks

Course Outcomes:

1.	CO1: Describe different multiplexing techniques
2.	CO2: Express the concepts of Digital Switching.
3.	CO3: Review the performance analysis of network traffic.
4.	CO4: Outline the ISDN architecture and Digital Loop Carrier Systems.
5.	CO5: Analyze the Characteristics of a network.

Description of Contents in brief:

1.	Basic of Switching System, Simple Telephone Communication, Manual Switching System, Major Telecommunication Networks
2.	Digital Switching: Switching Functions, Space Division Switching, Time Division Switching, two dimensional Switching
3.	Traffic Engineering, Queuing systems: Erlang Distribution, probability of delay, Finite queue capacity, systems with a single server, Queues in tandem, delay tables and application of Delay formulae.
4.	Telephone Networks: Subscriber Loop System, Switching Hierarchy And Routing, Transmission Plan, Transmission System Numbering Plan, Charging Plan, Signaling Techniques, In-channel Signaling, Common Channel Signaling, Cellular Mobile Telephony.
5.	Digital Subscriber Access : ISDN: ISDN Basic Rate Access Architecture, ISDN U Interface, ISDN D Channel Protocol. High-Data-Rate Digital Subscriber Loops: Asymmetric Digital Subscriber Line, VDSL. Digital Loop Carrier Systems: Universal Digital Loop Carrier Systems, Integrated Digital Loop Carrier Systems
6.	Cellular Mobile Telephony.

List of Text Books:

1.	ThiagarajanViswanathan&ManavBhatnagar, “Telecommunication Switching Systems andNetworks”, PHI.
2.	J.E. Flood, Telecommunications Switching, Traffic and Networks, Prentice Hall, 1995

List of Reference Books:

1.	James Martin, “Telecomm. & the Computers”, PHI.

2.	Network Traffic Engineering: Models and Applicationsby Andrea Baiocchi Aug 11, 2020

URLs:

1.	http://www.kopykitab.com/product/7654

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1.	Basic of Switching System, Simple Telephone Communication
2.	Manual Switching System, Major Telecommunication Networks Strowger
3.	Rotary Dial Telephone Signaling Tones, Step by Step Switching
4.	Design Parameters, Crossbar Switching: Principal of Common Control
5.	Tutorial-1
6.	Touch Tone Dial Telephone
7.	Principals of Crossbar Switching
8.	Digital Switching: Switching Functions, , ,.
9.	Space Division Switching
10.	Time Division Switching
11.	Two dimensional Switching: STS Switching, TST Switching
12.	Digital Cross- Connect Systems
13.	Digital Switching in an Analog Environment
14.	Traffic Engineering: Queuing systems
15.	Tutorial-2
16.	Erlang Distribution, probability of delay
17.	Finite queue capacity, systems with a single server
18.	Queues in tandem, delay tables and application of Delay formulae
19.	Analysis: Traffic Characteristics: Arrival Distributions, Holding time Distribution.
20.	Loss Systems: Lost calls cleared
21.	lost calls returning, lost calls Held, lost calls cleared
22.	Tutorial-3
23.	Telephone Networks: Subscriber Loop System
24.	Switching Hierarchy And Routing
25.	Transmission Plan
26.	Transmission System
27.	Numbering Plan,
28.	Charging Plan,
29.	Signaling Techniques In-channel Signaling, Common Channel Signaling
30.	Cellular Mobile Telephony
31.	Tutorial-3
32.	Digital Subscriber Access.
33.	ISDN: ISDN Basic Rate Access Architecture
34.	ISDN U Interface, ISDN D Channel Protocol
35.	High-Data-Rate Digital Subscriber Loops
36.	Asymmetric Digital Subscriber Line,
37.	VDSL.

38.	Digital Loop Carrier Systems
39.	Universal Digital Loop Carrier Systems
40.	Integrated Digital Loop Carrier Systems
41.	Tutorial-4

Name of Program	B. Tech	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	Satellite Communication		

Course Code	ECE 355
Core / Elective / Other	Elective

Prerequisite:

1.	Basic concepts of analog communication systems
2.	Basic concepts of digital communication systems

Course Outcomes:

1.	After studying this course the students would know the principles, concepts and operation of communication satellite systems.
2.	Describe the concepts of orbital mechanism, link design, rain fading and multiple access techniques used in satellite systems.
3.	Use software tools to simulate and analyse the performance of satellite communication systems, link analysis with given data and multiplexing techniques.
4.	Students would acquire the knowledge of different types of satellite systems and their applications.

Description of Contents in brief:

1.	Introduction, History of Satellites, Kepler‟s law, Elements of orbital mechanics. Equations of motion. Tracking and orbit determination.
2.	Orbital correction/control. Satellite launch systems. Geostationary Satellites, Satellite System Parameters Elements of communication satellite design.
3.	Spacecraft subsystems. Reliability considerations. Spacecraft integration.
4.	Multiple access techniques. FDMA, TDMA, CDMA. Random access techniques. Satellite onboard processing.
5.	Satellite link design: Performance requirements and standards. Design of satellite links – DOMSAT, INSAT, Intelsat and Inmarsat. Satellite - based personal communication.
6.	Earth station design. Configuration. Antenna and tracking systems. Satellite broadcasting.

List of Text Books:

1.	Design of Geosynchronous Spacecraft by B.N. Agrawal
2.	Satellite Communications by Robert M. Gagliardi

List of Reference Books:

1.	Satellite Communication by D.Roddy
2.	Satellite Communication by T.Pratt and C.W. Bostain

URLs:

1.	https://en.wikipedia.org/wiki/Communications_satellite

Lecture Plan (about 40-50 Lectures):

Lecture No.	Topic
1.	Introduction and history of satellite communication
2.	Kepler's Law
3.	Elements of Orbital Mechanics
4.	Equation of motion
5.	Tutorial
6.	Tracking and Orbit Determination
7.	Orbital correction/control
8.	Orbital correction/control
9.	Tutorial
10.	Launchers
11.	Satellite Launch Systems
12.	Geostationary Satellites
13.	Satellite System Parameters Elements of Communication Satellite Design
14.	Satellite System Parameters Elements of Communication Satellite Design
15.	Spacecraft Subsystem
16.	Spacecraft Subsystem
17	Tutorial
18.	Space Segment subsystem
19.	Earth Segment Subsystem
20.	Reliability Consideration
21.	Spacecraft Integration
22.	Modulation Techniques of Satellite Links
23.	Tutorial
24.	Multiple Access Techniques
25.	Multiple Access Techniques
26.	Single Access Vs Multiple Access
27.	FDMA
28.	TDMA
29.	CDMA
30.	Tutorial
31.	Onboard Signal Processing for FDMA/TDMA Operation
32.	Random Access Techniques
33.	Satellite onboard processing
34.	Performance requirements and standards
35.	Tutorial
36.	DOMSAT
37.	INSAT
38.	Intelsat
39.	Inmarsat
40.	Satellite Based Personal Communication
41.	Tutorial
42	Earth Station Design
43	Example of Earth Stations
44	Configuration of Satellite link Design
45	Configuration of Satellite link Design

46	Antenna and Tracking Systems
47	Satellite Broadcasting

Name of Program	B. Tech.	**Semester V/VI/VII/VIII**	**Year** 3rd/4th
Name of Course	Optimization Techniques		
Course Code	ECE 356		
Core / Elective / Other	Elective		
Prerequisite:			
1.	Fundamentals of Computing and Programming		
2.			
3.			
Course Outcomes:			
1.	Use classical optimization techniques and numerical methods of optimization		
2.	Describe the basics of different evolutionary algorithms.		
3.	Enumerate fundamentals of Integer programming technique and apply different techniques to solve various optimization problems arising from engineering areas.		
Description of Contents in brief:			
1.	mathematical review for optimization,matrixfactorizations,sets and sequences, convex setsand functions		
2.	linear programming ,simplex method, Weierstrass' theorem, Karush Kuhn Tucker optimality conditions		
3.	Algorithms for optimization I, Algorithms for optimization II, Algorithms for optimization III, Algorithms for optimization IV, Algorithms for optimization V		
4.	Convergence, unconstrained optimization, Linesearch methods method of multidimensional search I , method of multidimensional search II, Simplex algorithm		
5.	steepest descent methods I, steepest descent methods II, steepest descent methods III, Gradient Search Methods I, Gradient Search Methods II, Gradient Search Methods III, Newton's method, modifications to Newton's method, trust region methods I, trust region methods II, conjugate gradient methods I, conjugate gradient methods II		
6.	Newton's method, modifications to Newton's method, trust region methods I, trust region methods II, conjugate gradient methods I, conjugate gradient methods II Constrained optimization, quasi-Newton's methods I, quasi-Newton's methods II penalty and barrier function methods I, penalty and barrier function methods II, augmented Lagrangian methods, successive linear programming, Successive quadratic programming.		
List of Text Books:			
1.	Practical Optimization R. Fletcher.		
2.	Nonlinear Programming, Theory and Algorithms, M.S.Bazara, H.D.SheraliandC.Shetty		
3.	Optimization for Engineering Design by Kalyanmoy Deb, PHI Publishers		
1.	Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers 3		
2.	Operations Research by Hillar and Liberman, TMH Publishers		
3.	Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers		

URLs:	
1.	https://books.google.co.in/books/about/Advanced_Optimization_Techniques
2.	https://nptel.ac.in/content/storage2/courses/105108127/pdf/Module_1/M1L4slides.pdf
3.	

Lecture Plan (about 40-50 Lectures):

Lecture No.	Topic
1	mathematical review for optimization
2	matrix factorizations
3	sets and sequences
4	convex setsand functions
5	linear programming
6	simplex method
7	Weierstrass' theorem
8	Karush Kuhn Tucker optimality conditions
9	Algorithms for optimization I
10	Algorithms for optimization II
11	Algorithms for optimization III
12	Algorithms for optimization IV
13	Algorithms for optimization V
14	convergence
15	unconstrained optimization
16	Linesearch methods
17	method of multidimensional search I
18	method of multidimensional search II
19	Simplex algorithm
20	steepest descent methods I
21	steepest descent methods II
22	steepest descent methods III
23	Gradient Search Methods I
24	Gradient Search Methods II

25	Gradient Search Methods III
26	Newton's method
27	modifications to Newton's method
28	trust region methods I
29	trust region methods II
30	conjugate gradient methods I
31	conjugate gradient methods II
32	Constrained optimization
33	quasi-Newton's methods I
34	quasi-Newton's methods II
35	penalty and barrier function methods I
36	penalty and barrier function methods II
37	augmented Lagrangian methods
38	polynomial time algorithm for linear programming
39	successive linear programming
40	Successive quadratic programming.

Name of Program	BTECH	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	Computer Networks		
Course Code	ECE 357		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Introduction to telephony
2.	Integrated networks
3.	Multiplexing schematics
Course Outcomes:	
1.	Explain the networks, topologies and layers of OSI model,compare with TCP/IP model.
2.	Classify error control and flow control techniques and typesof LAN technologies.
3.	Analyze different routing algorithms and methods to improve QOS.
4.	Summarize the transport layer protocols and congestion controls methods.
5.	Describe various application layer services and cryptographic techniques
Description of Contents in brief:	
1.	Introduction Concepts: Goals and Applications of Networks,OSI and TCP-IP Model
2.	Physical Layer, Transmission Media, Line coding
3.	Functions of Data link layer and DLL Protocols,MAC layer protocols
4.	Network layer and routing algorithums
5.	Transport Layer: TCP and UDP, Application Layer, Other application. Overview of IEEE standards
6.	Example of Networks – Internet, Public Switched Network (PSTN), ISDN, B-ISDN and ATM Networks.
List of Text Books:	
1.	Data Communication and Networking Forouzen
2.	Computer Networks A.S. Tanenbaum
3.	Data and Computer Communication W. Stallings.
List of Reference Books:	
1.	Data Networks D.P. Bertsekas, R.G. Gallager
2.	ISDN and B-ISDN W. Stallings
URLs:	
1.	http://www.saylor.org/courses/cs402/
2.	http://www.cs.vu.nl/~ast/
3.	https://onlinecourses.**nptel**.ac.

Lecture Plan (about 40-50 Lectures):

Lecture No.	Topic
1.	Introduction Concepts: Goals and Applications of Networks, Flow Control
2.	Network Topologies and architecture
3.	The OSI reference model
4.	Physical Layer, Transmission Media
5.	Line coding: Uni-polar, Bi-polar, RZ, NRZ, Menchester and Differential Menchester codes
6.	Switching methods Circuit, message, packet switchings
7.	Functions of Data link layer
8.	Framing, Error control
9.	DLL protocol stop and wait
10.	Sliding window protocols,
11.	Tutorial-1
12.	Medium Access control (MAC) sub layer
13.	MAC protocols: ALOHA
14.	Slotted ALOHA
15.	Token bus, Token Ring,
16.	Round Robin, CSMS/CA,
17.	Bit mapped protocol, Carrier Sense Multiple Access (CSMA)
18.	Collision Avoidance, Collision Detection
19.	p-Persistent, 1-Persistent
20.	Non-Persistent spectrum sensing
21.	Ethernet frame
22.	Tutorial-2
23.	Network Layer
24.	logical addressing (i.e. IPv4 addresses and header
25.	Routing algorithms
26.	Least cost routing algorithms
27.	Dijkstra and Bellman Ford algorithms
28.	Transport Layer: TCP and UDP
29.	Application Layer, Other application.
30.	Overview of IEEE standards
31.	IEEE 802.3(LAN)
32.	IEEE 802.11a,b,g,n (WLAN)
33.	IEEE 802.15 (PAN)
34.	FDDI
35.	Tutorial-3
36.	Networking Devices: Bridge
37.	Hub, Switch, Router
38.	Gateway, Servers
39.	Example of Networks – Internet
40.	Cryptography
41.	ISDN, B-ISDN and ATM Networks
42.	Tutorial-4

Name of Program	B. Tech	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	Computer Engineering		
Course Code	ECE 358		
Core / Elective / Other	Elective		

Prerequisite:

1.	The students are well versed with the fundamentals Basic electronics.
2.	The students are well versed with the fundamentals Digital electronics.

Course Outcomes:

1.	The students will be able to describe the fundamental organisation of a computer system.
2.	The students will be able to explain the functional units of a processor.
3.	The students will be able to **e**xplain addressing modes, instruction formats and program control statements.
4.	The students will be able to distinguish the organization of various parts of a system memory hierarchy.
5.	The students will be able to describe basic concept of parallel computing.

Description of Contents in brief:

1.	Basic building blocks of a computer, Register transfer language, Register transfer, Bus implementation via multiplexer and three-state buffer, arithmetic, logic and shift microoperations and their hardware implementation. Implementation of ALU. Instruction format, instruction set and different addressing modes.
2.	Control unit organization – Hardwired and micro programmed control unit, address sequencing, micro instruction format, routines, microprogramming, micro program sequencer.
3.	Computer arithmetic – Number representation, hardware and algorithms for fixed point and floating point arithmetic– addition, subtraction, multiplication and division. Parallel processing, Flynn's classification, Pipelining.
4.	Input/Output organization- Peripheral devices, Input-Output interface, data transfer schemes, modes of transfer, Priority interrupt, DMA, I/O processors.
5.	Memory management – Memory hierarchy, Main memory, Auxiliary memory, Associative memory, Cache memory, Virtual memory. Introduction of system software components: operating system, assembler, linker, compiler.

List of Text Books:

1.	M. Moris Mano, "Computer Systems Architecture", 4th Edition, Pearson/PHI, ISBN:10:0131755633
2.	Carl Hamacher, ZvonkoVranesic, SafwatZaky, "Computer Organization", 5 th Edition, McGraw Hill.

3.	Gear C. W., “Computer Organization and Programming”, McGraw Hill.

List of Reference Books:

1.	John L. Hennessy and David A. Patterson, “Computer Architecture a quantitative approach”, 4th Edition Elsevier, ISBN:10:0123704901
2.	William Stallings, “Computer Organization and Architecture”, 6th Edition, Pearson/PHI, ISBN:10:0-13-609704-9
3.	Tennenbaum, “Structured Computer Organization”, PHI.

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1.	Basic building blocks of a computer.
2.	Register transfer language.
3.	Register transfer.
4.	Bus implementation via multiplexer.
5.	Three-state buffer.
6.	Arithmetic, logic and shift microoperations and their hardware implementation.
7.	Arithmetic, logic and shift microoperations and their hardware implementationcontd…..
8.	Implementation of ALU.
9.	Instruction format, instruction set.
10.	Different addressing modes.
11.	Control unit organization – Hardwired and micro programmed control unit.
12.	Control unit organization – Hardwired and micro programmed control unit contd….....
13.	Address sequencing.
14.	Micro instruction format.
15.	Routines.
16.	Microprogramming.
17.	Micro program sequencer.
18.	Computer arithmetic – Number representation.
19.	Hardware and algorithms for fixed point and floating point arithmetic– addition, subtraction, multiplication and division.
20.	Hardware and algorithms for fixed point and floating point arithmetic– addition, subtraction, multiplication and divisioncontd….
21.	Hardware and algorithms for fixed point and floating point arithmetic– addition, subtraction, multiplication and divisioncontd….
22.	Hardware and algorithms for fixed point and floating point arithmetic– addition, subtraction, multiplication and divisioncontd….
23.	Hardware and algorithms for fixed point and floating point arithmetic– addition, subtraction, multiplication and divisioncontd….
24.	Parallel processing.
25.	Flynn’s classification.
26.	Pipelining.
27.	Input/Output organization- Peripheral devices.
28.	Input/Output organization- Peripheral devicescontd….
29.	Input-Output interface.

30.	Data transfer schemes.
31.	Modes of transfer.
32.	Priority interrupt.
33.	DMA
34.	I/O processors
35.	Memory management – Memory hierarchy.
36.	Main memory
37.	Auxiliary memory
38.	Associative memory
39.	Cache memory
40.	Virtual memor
41.	Introduction of system software components: operating system
42.	Assembler
43.	Linker
44.	Compiler

ELECTIVES FOR 4TH YEAR

Name of Program	B. Tech.	**Semester V/VI/VII/VIII**	**Year** 3rd/4th
Name of Course	Physical Design Automation		
Course Code	ECE 451		
Core / Elective / Other	Elective		

Prerequisite:	
1.	VLSI Design
2.	
3.	
Course Outcomes:	
1.	Study automation process for VLSI System design
2.	Understanding of fundamentals for various physical design CAD tools.
3.	Develop and enhance the existing algorithms and computational techniques for physical design process of VLSI systems
Description of Contents in brief:	
1.	The course introduce the basic design fow in VLSI physical design automation.
2.	Basic data structures and algorithms used for implementing
3.	Examples and assignments to understand the concepts involved in physical design automation and appreciate the main challenges therein
List of Text Books:	
1.	N.A. Sherwani, "Algorithms for VLSI Physical Design Automation",,Kluwer Academic
2.	Sadiq M Sait, "VLSI Physical Design Automation: Theory and Practice
List of Reference Books:	
1.	Gerez,Sabih H., "Algorithms for VLSI Design Automation", John Wiley & Sons
2.	Drechsler, Rolf, "Evolutionary Algorithms for VLSI CAD" Springer Science & Business Media
3.	Trimberger, Stephen M., "An Introduction to CAD for VLSI", Springer Science & Business Media
URLs:	
1.	www.worldscientific.com › VLSI DESIGN AUTOMATION
2.	www.electronicshub.org/cmos-technology
Lecture Plan (about 40-50 Lectures):	

Lecture No.	Topic
1	Design Representation
2	VLSI Design cycle
3	VLSI Design Styles

4	VLSI Physical Design Automation (Part 1)
5	VLSI Physical Design Automation (Part 2)
6	Partitioning
7	Floor planning
8	Floor planning Algorithms
9	Pin Assignment
10	Placement (Part 1)
11	Placement (Part 2)
12	Grid Routing (Part 1)
13	Grid Routing (Part 2)
14	Global Routing (Part 1)
15	Global Routing (Part 2)
16	Detailed Routing (Part 1)
17	Detailed Routing (Part 2)
18	Clock Design (Part 1)
19	Clock Design (Part 2)
20	Clock and Network synthesis
21	POWER AND GROUND ROUTING
22	Time Closure
23	Timing Driven Placement
24	Timing Driven Routing
25	Physical Synthesis (Part 1)
26	Performance-Driven Design Flow
27	Interconnect Modeling
28	Design Rule Check
29	Layout Compaction
30	Test Pattern Generation
31	Design for Testability
32	Boundary Scan Standard
33	Built-in Self-Test (Part 1)
34	Low Power VLSI Design
35	Techniques to Reduce Power
36	Gate Level Design for Low Power

37	Algorithmic Level Techniques for Low Power Design
38	PDA
39	FPGAs
40	MCMs

Name of Program	B. Tech.	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	**CMOS RF circuit Design**		
Course Code	ECE 452		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Knowledge of MOS Transistors
2.	Design of Analog CMOS circuit
3.	
Course Outcomes:	
1.	Understand principles, analysis, and design of CMOS Radio frequency (RF) circuits for wireless communication systems
2.	Understand principles, analysis, and design of CMOS Radio frequency (RF) circuits for wireless communication systems
3.	Design of Components in CMOS RF Circuit
Description of Contents in brief:	
1.	RF Transceiver system design concept
2.	Device Noise calculation and analysis
3.	low-noise amplifiers (LNA) designs,
4.	Power amplifier design
5.	Oscillators Ring , LC cross-coupled, Colpitts, Hartly, Voltage control oscillators
List of Text Books:	
1.	B. Razavi , “RF Microelectronics”, Prentice Hall of India
2.	R. Jacob Baker, H.W. Li and D.E. Boyce, “CMOS Circuit Design, Layout and Simulation”,Prentice Hall of India
3.	Thomas H. Lee “Design of CMOS RF Integrated Circuits”, Cambridge University press
List of Reference Books:	
1.	Y.P. Tsividis, “Mixed Analog and Digital VLSI Devices and Technology”, McGraw Hill.
2.	P. Allen & D. R. Holberg, CMOS Analog Circuit Design, Oxford Press,
3.	P. Gray, P. Hurst, S. Lewis, R. Meyer, Analysis and Design of Analog Integrated Circuits, Wiley-In
URLs:	
1.	www.CMOScircuit.com
2.	www.anylogic.com/resources/books/free-simulation-book-and-modeling-tutorials
3.	www.electronicshub.org/cmos-technology

Lecture Plan (about 40-50 Lectures):

Lecture No.	Topic
1	Transceiver architecture

2	Transmitter and receiver design
3	MOS small signal model
4	MOS large signal model
5	Analysis of different types of noise in RF communication
6	Derivations on Thermal noise
7	Device noise
8	Flicker noise
9	Numericals on different types of noise in RF communication
10	Analysis of different capacitances in MOSFET
11	Passive devices
12	Uses of passive devices in RF circuit design
13	RF inductor design
14	MOS varactor design
15	Building block in RF systems
16	Oscillators in RF communication system
17	Common source amplifier
18	Ring oscillator design using single common source stage
19	Ring oscillator design using two common source stage
20	Ring oscillator design using multiple common source stage
21	Numericals on Ring oscillator
22	One port view of oscillator
23	LC oscillator
24	Conversion of series resistance to parallel
25	Cross coupled LC Oscillator design
26	Numericals on LC Oscillator
27	Cross coupled Oscillator
28	Numericals on Cross coupled Oscillator
29	Voltage Control Oscillator

30	VCO tuning range limitations
31	Numericals on VCO
32	Basics of LNA, important parameters
33	LNA design issues
34	LNA broadband topology
35	Noise cancelling LNA
36	Different configurations of differential LNA
37	Power amplifier basics
38	Design of power amplifier
39	Single ended and differential power amplifier
40	High efficiency power amplifier
41	Numericals on power amplifier

Name of Program	B Tech	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	Low Power VLSI Design		
Course Code	ECE 453		
Core / Elective / Other	Elective		

Prerequisite:

1.	Linear Integrated Circuits
2.	VLSI Design EC
3.	

Course Outcomes:

1.	Design levels (mainly circuit, transistor, and gate).
2.	Power optimization for combinational and sequential circuits
3.	Leakage power consumption in deep submicron technologies Power analysis and design at system level Case studies.

Description of Contents in brief:

1.	Modeling and sources of power consumption,
2.	Power estimation at different design levels(mainly circuit, transistor, and gate) Power optimization for combinational circuits
3.	Power optimization for sequential circuits Circuit
4.	Circuit Layout level for low power
5.	Leakage power in deep sub-micron technologies Power analysis and design at system level. Case studies.

List of Text Books:

1.	Low Power CMOS VLSI Circuit Design Kaushik Roy, Sharat Prasad
2.	Practical Low Power Digital VLSI Design Gary Yeap
3.	

List of Reference Books:

1.	Low Power Design in Deep Sub-micron Electronics W. Nebel and J. Mermet, Kluwer
2.	
3.	

URLs:

Lecture Plan (about 40-50 Lectures):

Lecture No.	Topic
1.	Introduction to VLSI design and modern era of Tecnology scaling
2.	Effects and fundamental of technology scaling

3.	Transistors in DSM technogoly, concepts and FinFets, etc
4.	Introduction To low power Design
5.	Sources of Power Consumption
6.	Power Estimation: ProbablisticTechique for signal Activity estimation I
7.	Power Estimation: ProbablisticTechique for signal Activity estimation I
8.	Power Estimation: ProbablisticTechique for signal Activity estimation I
9.	Estimation of gliching Power
10.	Power dissipation in domino CMOS
11.	Power consumption of CMOS gates
12.	Leakage currents in DSM
13.	Leakage Power Consumption in deep submicron technologies.I
14.	Leakage Power Consumption in deep submicron technologies.II
15.	Tuotorial I
16.	Techniques for Leakage Power Reduction I
17.	Techniques for Leakage Power Reduction II
18.	Techniques for Leakage Power Reduction III
19.	Techniques for Leakage Power Reduction IV
20.	Techniques for Leakage Power Reduction V (Supply voltage scaling)& Self adjusting threshold scheme)
21.	Techniques for Leakage Power Reduction for minimizing switched capacitance I
22.	Techniques for Leakage Power Reduction for minimizing switched capacitance II
23.	Techniques for Leakage Power Reduction for minimizing switched capacitance III
24.	Techniques for Leakage Power Reduction for minimizing switched capacitance IV
25.	Techniques for Leakage Power Reduction for minimizing switched capacitance V
26.	Techniques for Leakage Power Reduction for minimizing switched capacitance VI
27.	Techniques for Leakage Power Reduction for minimizing switched capacitanceVII
28.	Techniques for Leakage Power Reduction for minimizing switched capacitanceVIII
29.	Techniques for Leakage Power Reduction for minimizing switched capacitanceIX
30.	Techniques for Leakage Power Reduction for minimizing switched capacitance X
31.	Tutorials
32.	Leakage reduction techniques, process level and circuit level techniques
33.	Design time leakage reduction technique
34.	Design time leakage reduction technique
35.	Run time standby leakage reduction techniques
36.	Run time standby leakage reduction techniques
37.	Run time standby leakage reduction techniques
38.	Run time Active leakage reduction techniques
39.	Run time Active leakage reduction techniques
40.	Run time Active leakage reduction techniques

Name of Program	B-Tech	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	**CAD of Digital Systems**		
Course Code	ECE 454		
Core / Elective / Other	**Elective**		

Prerequisite:

1.	

Course Outcomes:

1.	Fundamentals of CAD tools for modelling, design, test and verification of VLSI systems.
2.	Study of various phases of CAD, including simulation, physical design, test and verification.
3.	Demonstrate knowledge of computational algorithms and tools for CAD.

Description of Contents in brief:

1.	Introduction to VLSI Methodologies, Design domains and actions. Design methods andtechnologies. VLSI design automation tools
2.	Structural and transistor level design algorithmic and system design algorithmic graph theory and computational complexities
3.	Tractable and intractable problems, general purpose methods for combinational optimization,Layout compaction
4.	Placement and partitioning, Floor planning concepts, Routing definition and Concept
5.	Simulation – general remarks on VLSI simulation, gate level modeling and simulation switchlevel modeling and simulation logic synthesis and verification, high level synthesis

List of Text Books:

1.	S.H. Gerez, “Algorithms for VLSI Design Automation”, 1998
2.	N.A. Sherwani, “Algorithms for VLSI Physical Design Automation”, 1999
3.	JA Bondy, USR Murty “Graph Theory With Applications” Elsevier Science Publishing Co. Inc , 1982

List of Reference Books:

1.	Giovanni De Micheli ,“Synthesis And Optimization Of Digital Circuits”.
2.	
3.	

URLs:

1.	

Lecture Plan (about 40-50 Lectures):

Lecture No.	Topic
1	Introduction and Review to VLSI Methodologies,
2	VLSI Physical Design Automation
3	Design and Fabrication of VLSI Devices,
4	Fabrication process and its impact on Physical Design
5	VLSI design automation tools
6	Graph Theory Fundamentals.
7	Graph theory Definitions
8	More definitions and problems
9	Data structures and basic algorithms –
10	Analysis of algorithms
11	Graph theory
12	Computational complexity of Graph Theory
13	Asymptotic Notations, Big O notation
14	Breadth first search
15	Depth first search
16	Maximum flow Algorithm
17	Some problems on Algorithms
18	Dijkstras Algorithm
19	Prims algorithm
20	Floyd Warshall Algorithm
21	Kruskal Algorithm
22	Longest path Algorithm
23	Liao Wong Algorithm
24	4 queens problem and Travelling Salesman problem
25	Bellman Ford Algorithm
26	Tractable and intractable problems.
27	Polynomial nonpolynomial algorithms
28	Optimization algorithms tarvelling salesman problem
29	Dynamic programming
30	Branch and bound concept and examples
31	Back tracking and all pair shortest path algorithm
32	Definition of partitioning-floor planning and
33	Pin assignment
34	Placement algorithm
35	Floorplanning Algorithms
36	Routing algorithm (LEE algorithm)
37	Simulation – logic synthesis
38	High level synthesis compaction
39	Physical design automation of FPGAs, MCMS
40	VHDL-Verilog implementation of simple circuits using VHDL and Verilog

Name of Program	B. Tech	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	Nano Technology		
Course Code	ECE 455		
Core / Elective / Other	Elective		

Prerequisite:

1.	The students are well versed with the fundamentals of Applied Electronics.
2.	The students are well versed with the fundamentals of Microelectronics Circuits Design Practicum (MCDP).
3.	The students are well versed with the fundamentals of Electronics Devices.
4.	The students are well versed with the fundamentals of Solid State Physics.

Course Outcomes:

1.	Students will understand the divers electronic device fabrication.
2.	Students will be able to explain Nano Electronics.
3.	Students will be able to explain Nano –Microfabrication.

Description of Contents in brief:

1.	Tunnel junction and applications of tunneling, Tunneling Through a Potential Barrier, Metal—Insulator, Metal-Semiconductor, and Metal-Insulator-Metal Junctions, Coulomb Blockade, Tunnel Junctions, Tunnel Junction Excited by a Current Source. Spintronics and Foundations of nano-photonics.
2.	Field Emission, Gate—Oxide Tunneling and Hot Electron Effects in nano MOSFETs, Theory of Scanning Tunneling Microscope, Double Barrier Tunneling and the Resonant Tunneling Diode.
3.	Introduction to lithography- Contact, proximity printing and Projection Printing, Resolution Enhancement techniques, overlay-accuracies, Mask-Error enhancement factor (MEEF), Positive and negative photoresists, Electron Lithography, Projection Printing, Direct writing, Electron resists. Lithography based on Surface Instabilities: Wetting, De-wetting, Adhesion, Limitations, Resolution and Achievable / line widths etc. Lift off process, Bulk Micro machining.
4.	Introduction to MEMS and NEMS, working principles, as micro sensors (acoustic wave sensor, biomedical and biosensor, chemical sensor, optical sensor, capacitive sensor, pressure sensor and thermal sensor), micro actuation (thermal actuation, piezoelectric actuation and electrostatic actuation–micro gripers, motors, valves, pumps, accelerometers, fluidics and capillary electrophoresis, active and passive micro fluidic devices, Pizoresistivity, Pizoelectricity and thermoelectricity, MEMS/NEMS design, processing, Oxidation, Sputter deposition, Evaporation, Chemical vapor deposition etc.
5.	Introduction – Scaling of physical systems – Geometric scaling & Electrical system scaling. The Single-Electron Transistor: The Single- Electron Transistor Single-Electron Transistor Logic, Other SET and FET Structures, Carbon Nanotube Transistors (FETs and SETs), Semiconductor Nanowire FETs and SETs,Coulomb Blockade in a Nanocapacitor, Molecular SETs and Molecular Electronics.

List of Text Books:

1.	Stephen D. Sentaria, Microsystem Design, Kluwer Academic Press
2.	Marc Madou, Fundamentals of microfabrication & Nanofabrication.
3.	T. Fukada&W.Mens, Micro Mechanical system Principle & Technology, Elsevier, 1998.

List of Reference Books:

1.	Julian W.Gardnes, Vijay K. Varda, Micro sensors MEMS & Smart Devices, 2001.
2.	Nano Terchnology and Nano Electronics – Materials, devices and measurement Techniques by WR Fahrner – Springer.

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1.	Tunnel junction and applications of tunneling.
2.	Tunneling Through a Potential Barrier.
3.	Metal—Insulator, Metal-Semiconductor and Metal-Insulator-Metal Junctions.
4.	Coulomb Blockade.
5.	Tunnel Junctions, Tunnel Junction Excited by a Current Source.
6.	Spintronics.
7.	Foundations of nano-photonics.
8.	Field Emission.
9.	Gate—Oxide Tunneling.
10.	Hot Electron Effects in nano MOSFETs.
11.	Theory of Scanning Tunneling Microscope.
12.	Double Barrier Tunneling.
13.	Resonant Tunneling Diode.
14.	Introduction to lithography.
15.	Contact, proximity printing and Projection Printing.
16.	Resolution Enhancement techniques, overlay-accuracies.
17.	Mask-Error enhancement factor (MEEF).
18.	Positive and negative photoresists.
19.	Electron Lithography, Projection Printing.
20.	Direct writing, Electron resists.
21.	Litho.graphy based on Surface Instabilities
22.	Wetting, De-wetting, Adhesion, Limitations
23.	Resolution and Achievable / line widths etc.
24.	Lift off process.
25.	Bulk Micro machining.
26.	Introduction to MEMS and NEMS, working principles, as micro sensors (acoustic wave sensor, biomedical and biosensor, chemical sensor, optical sensor, capacitive sensor, pressure sensor and thermal sensor).
27.	Micro actuation (thermal actuation, piezoelectric actuation and electrostatic)
28.	Actuation–micro gripers, motors, valves, pumps, accelerometers, fluidics and capillary electrophoresis.
29.	Active and passive micro fluidic devices.
30.	Pizoresistivity,Pizoelectricity and thermoelectricity.

31.	MEMS/NEMS design processing.
32.	Oxidation.
33.	Sputter deposition
34.	Evaporation
35.	Chemical vapor deposition etc
36.	Introduction – Scaling of physical systems – Geometric scaling & Electrical system scaling
37.	The Single-Electron Transistor: The Single- Electron Transistor Single-Electron Transistor Logic
38.	Other SET and FET Structures.
39.	Carbon Nanotube Transistors (FETs and SETs).
40.	Semiconductor Nanowire FETs and SETs.
41.	Coulomb Blockade in a Nanocapacitor
42.	Molecular SETs.
43.	Molecular Electronics

Name of Program	BTech	**Semester V/VI/VII/VIII**	**Year** 3rd/4th

Name of Course	Embedded Systems
Course Code	ECE 456
Core / Elective / Other	Elective

Prerequisite:	
1	Programming with C
2	Data Structures
3	Microprocessors and Microcontrollers

Course Outcomes:	
1	Understanding of the Scope of Application and Hardware Software Co-Design of Embedded Systems
2	Identification of problems and their solutions in the software architectures for Embedded Systems
3	RTOS case study, IDE case study, Embedded System Program structure with example templates

Description of Contents in brief:	
1	Embedded System Design Issues
2	Hardware Software Codesign
3	Case Study of Digital Camera Design
4	Software Architectures, RTOS
5	Design with specific RTOS and Microcontroller – Micrium, PIC

List of Text Books:	
1	System Design: A Unified Hardware/Software Introduction – by- Frank Vahid, Tony Givergis (John Wiley & Sons)
2	An Embedded Software Primer – by - David Simon (Pearson)
3	Design with PIC Microcontroller – by - John B Peatman (Pearson)

List of Reference Books:	
1	Specification and Design of Embedded Systems – by – Gajski, Vahid, Narayan, Gong (Pearson)
2	Real Time Concepts for Embedded Systems – by - Qing Li and Caroline Yao (CMP Books - Wind River Systems)

URLs:	
1	https://www.cs.ccu.edu.tw/~pahsiung/courses/soc/notes/SoC_Design_Flow_Tools_Codesign_2005_notes.pdf
2	esd.cs.ucr.edu/toc.html#toc_ch7
3	https://ptolemy.berkeley.edu/projects/embedded/research/hsc/

Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**
1.	Introduction to Embedded Systems, Motivation for study – Application

	areas, Market Economy
2.	Embedded System Design Issues, Domain knowledge required for all the aspects of the subject
3	Overview of Hardware Software Codesign
4	Codesign Flow chart discussion, Design Space Exploration
5	Elevator controller example – Representations and implementations
6	Processor Technologies – Controller and Data path variations
7	IC Technologies
8	Digital camera example – functionality block diagram
9, 10	Digital camera example – Implementation alternatives
11	Digital camera example – Implementation alternatives and Analysis
12	Computation models – Sequential program, FSMD – Elevator controller
13	Concurrency – HCFSM, PSM
14	Data flow model, Concurrent process model
15	System Partitioning – Structural/Functional, Partitioning Issues
16	Partitioning algorithms – Random mapping, Hierarchical clustering
17	Group migration
18	Ratio-cut
19	Simulated Annealing
20	Genetic Evolution
21	Design Quality Estimation
22	Hardware Estimation Model
23	Software Estimation Model
24	Buses and Protocols
25	RTOS – Features, Task structure, RTOS Data structure
26	Shared data problem
27	RTOS primitives – Semaphores and their usage
28	RTOS primitives – Queues and their usage
29	RTOS calls (Micrium OS)
30	RTOS memory management calls
31	Embedded Systems Development Tool Chain
32, 33	PIC microcontroller
34	PIC instruction set
35	PIC programming examples
36	PIC program template
37	PIC program – Blink Example
38	PIC program – Table usage
39	PIC Timer and Interrupt structure
40	PIC program – Interrupt usage

Name of Program	B.Tech	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$

Name of Course	Broadband Optical Communication
Course Code	ECE 457
Core / Elective / Other	**Elective**

Prerequisite:

1.	Optical Communication

Course Outcomes:

1.	To get a basic understanding of Broadband communication Technologies
2.	To get a profound understanding of protocols applied in optical networks i.e. SONET/ SDH, Metropolitan-Area Networks, Fiber-optic LAN architectures and protocols.
3.	To get a profound understanding of optical Communication, switching methods and networking techniques and understanding basics of lasers and photo-detectors
4.	To get a basic understanding of optical components employed in optical networks, optical node design, Access network – its dynamics and architecture.
5.	Capable of analyzing & configuring optical networks for specific applications.

Description of Contents in brief:

Intd. to Broadband Communication Technologies & various components employed: Different types of optical fibers, Modal analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR. Optical sources - LEDs and Lasers, Photo-detectors – PIN &APD.Optical link design - BER calculation WDM & DWDM systems & their Design topologies.
Introduction to Optical Networks; SONET / SDH, IP-SONET-WDM, Metropolitan-Area Networks, Fiber-optic LAN architectures and protocols- ring, star and bus architectures, DQDB, FDDI; High speed bus protocols.

WDM Networks - Light path Topology, Broadcast and Select Networks – Topologies for Broadcast Networks, Testbeds for Broadcast & Select WDM; Wavelength Routing Architecture. The optical layer, Node Designs, Routing and wavelength assignment, Switch-based Optical networks; Optical Access Network Architectures, Future Access Networks, All Optical Networks

List of Text Books:

1.	Rajiv Ramaswamy and Kumar N. Sivarajan, "Optical Networks", 2nd Edition, Morgan Kaufmann Publishers (Elsevier)
2.	Fibre Optic communication, J. Keiser, McGraw-Hill, 5^{th} Ed.

List of Reference Books:

1.	Fiber optic Communication Systems, G. Agrawal John Wiley and sons

Lecture Plan (about 40-50 Lectures): (Tentative)

Lecture No.	**Topic**
1.	Fundamentals of telecom systems

2.	Principles of communication and signaling
3.	Fundamentals of transmission
4.	Optical Fiber Modes & configurations.
5.	Types of Fibers : Single Mode & Multimode
6.	Single Mode Fibers, Mode Field diameter, Propagation
7.	Design of Single Mode Fibers
8.	Intd. to Fiber manufacturing
9.	Attenuation, Scattering & Bending losses, Absorbtion.
10.	Signal Distortion, Group Delay, Dispersion: Intermodal
11.	Signal Distortion, Group Delay, Dispersion: Intermodal
12.	Dispersion in Optical Fibers
13.	Dispersion in Single Mode Fibers
14.	WDM Systems, DWDM, Dispersion management
15.	WDM Systems, DWDM, Dispersion management
16.	Intd. to Optical Amplifiers, EDFA
17.	Intd. to Optical Amplifiers, EDFA
18.	Mathematical models for networks
19.	Mathematical models for networks
20.	Protocols, Architectures for Broadband Networks
21.	Protocols, Architectures for Broadband Networks
22.	Access and Hybrid Networks
23.	All optical networks. SDH
24.	All optical networks. SDH
25.	SONET
26.	Midterm
27.	Fiber-optic LAN architectures and protocols
28.	Fiber-optic LAN architectures and protocols
29.	Ring,star and bus architectures
30.	DQDB, FDDI; High speed bus protocols
31.	RATO-net, WDM networks- LAMBDA-net
32.	Coherent star, PASS-net, shuffle-net
33.	Midterm
34.	Photonic Switching
35.	Photonic Switching
36.	Switching architectures single and multistage switching
37.	Switching architectures single and multistage switching
38.	Space switching, time switching
39.	Space switching, time switching
40.	Combinations of space and time switching
41.	SEED arrays WDM Network design
42.	SEED arrays WDM Network design
43.	Lightpath Topology
44.	Optical Line Terminal
45.	Optical Add / Drop multiplexers
46.	Optical Cross connects and Wavelength conversion
47.	Optical Cross connects and Wavelength conversion

Name of Program	B.Tech.	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	Wireless Communication		
Course Code	ECE 458		
Core / Elective / Other	**Elective**		

Prerequisite:

1.	Analog Communication
2.	Digital Communication
3.	Signal Processing

Course Outcomes:

1.	Understanding fading and multipath fading, types of fading channels
2.	learning mitigation techniques to remove impact of fading.
3.	learning basics of the infrastructure less network (Adhoc network)
4.	Understanding more efficient frequency spectrum utilization technique Cognitive Radio Communication.
5.	Capable to analyse and understand various types of wireless communication standards.

Description of Contents in brief:

1.	**Wireless channels**: Orthogonal Frequency Division Multiplexing (OFDM), OFDMA, Fading and fading channel models- AWGN, Rayleigh, Rician, Nakagami,
2.	Multiple Input and Multiple Output (MIMO), millimetre waves. Interlevear and De-Interleaver, Equalizer, Forward correction codes, Linear block code, Convolutional coding and decoding, Turbo coding and decoding, Viterbi algorithm.
3.	**Mobile AdhocNetwork(MANet)** : Infrastructure less network, Medium access Protocols for MANet, Routing Protocols, Wireless Sensor Networks: Distributed Sensing Nodes, Power saving medium access protocols, IEEE 808.15.4.
4.	**Cognitive Radio Network (CRN)**: Spectrum Sensing Techniques: Energy Detector, Cyclostationary Detector, Marched Filter Detector, Radio Identification Detector, Cyclo-Energy Detector etc. Cooperative spectrum Sensing: Data and Decision cooperative spectrum sensing, Fusion Center, Spectrum Allocation Techniques, IEEE 802.22 (WRAN).
5.	**Wireless Access Networks:** WLAN, IEEE 802.11, WiMAX, IEEE 802.16, LTE, Ultra Wide-Band (UWB).

List of Text Books:

1.	"Wireless Communications:Principles and Practice", by T.S. Rappaport, Prentice Hall publication.
2.	Ad Hoc Networking", by Perkins, Pearson publication, 2008 Edition
3.	"A survey of spectrum sensing algorithms for cognitive radio Applications", TevfikYucek, HuseyinArslan, IEEE communications survey & tutorials, vol. 11, no. 1, 2009, pp. 116-129.

List of Reference Books:

1.	"Introduction to Wireless and Mobile Systems", by Dharma PrakashAgrawal, Qing-An Zeng, Cengage Learning publication.
2.	"Ad Hoc Mobile Wireless Networks", by Sudhir K. Sarkar, T.G. Basavraju, C. Puttamadappa, CRC publication
3.	"Cyclo-energy detector for spectrum sensing in cognitive radio", Lei Yang, Zhe Chen, Fuliang Yin, International Journal of Electronics and Communications (AEÜ), 66 (2012), pp. 89-92.
4.	"Wireless and Cellular Communications", by William C.Y. Lee, McGRAW-HILL Publication.

URLs:

1.	https://nptel.ac.in/courses/117104099/
2.	https://nptel.ac.in/courses/106/106/106106167/

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1.	Orthogonal Frequency Division Multiplexing (OFDM)
2.	OFDMA
3.	Fading
4.	fading channel models- AWGN
5.	Rayleigh
6.	Rician
7.	Nakagami
8.	AWGN, Rayleigh for BPSK
9.	Multiple Input and Multiple Output (MIMO),
10.	millimetre waves.
11.	Interlevear and De-Interleaver,
12.	Equalizer,
13.	Forward correction codes, Linear block code,
14.	Convolutional coding and decoding,
15.	Turbo coding and decoding,.
16.	Viterbi algorithm
17.	**Mobile Adhoc Network(MANet)** : Infrastructure less network
18.	Medium access Protocols for MANet
19.	Medium access Protocols for MANet continued
20.	Routing Protocols
21.	Wireless Sensor Networks
22.	Distributed Sensing Nodes,
23.	Power saving medium access protocols,
24.	IEEE 808.15.4.
25.	**Cognitive Radio Network (CRN)**: Spectrum Sensing Techniques
26.	Energy Detector
27.	Cyclostationary Detector
28.	Matched Filter Detector
29.	Radio Identification Detector
30.	Cyclo-Energy Detector

31.	Cooperative spectrum Sensing: Data and Decision cooperative spectrum sensing
32.	Cooperative spectrum Sensing: Data and Decision cooperative spectrum sensing continued
33.	Fusion Center
34.	Spectrum Allocation Techniques
35.	IEEE 802.22 (WRAN).
36.	**Wireless Access Networks:** WLAN
37.	IEEE 802.11
38.	WiMAX
39.	IEEE 802.16, LTE
40.	Ultra Wide-Band (UWB)

Name of Program	BTech	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	Computer Vision and Pattern Recognition		
Course Code	ECE 459		
Core / Elective / Other	Elective		

Prerequisite:

1.	Digital Image Processing

Course Outcomes:

1.	Introduce students to the major ideas, methods, and techniques of Computer Vision and image classification.
2.	To demonstrate the fundamentals and techniques of pattern recognition and detection.
3.	To make students familiar with various issues in the design of pattern recognition and classification systems.
4.	Students will be able to select and extract the appropriate features form images of diverse application.
5.	Students will be able to develop domain specific classification models.

Description of Contents in brief:

1.	Image Formation and Imaging Systems
2.	Image Processing
3.	Pattern Recognition
4.	Fearure Selection
5.	Classification Models
6.	Artificial Neural Networks

List of Text Books:

1.	Pattern Classification by Duda, Hart, and Stork, 2nd edition, John Wiley Interscience, 2012.
2.	Computer Vision: A Modern Approach, D.A. Forsyth and J. Ponce, Prentice-Hall, 2015.

List of Reference Books:

1.	The Elements of Statistical Learning T. Hastie et al., Springer-Verlag, 2013.
2.	Machine Learning: A probabilistic Perspective K. Murphy, MIT Press, 2012.
3.	Computer Vision, L.G. Shapiro and G. Stockman, Prentice-Hall, 2001.
4.	Artificial Intelligence: A Modern Approach, Stuart J. Russell and Peter Norvig, 3rd Edition, Pearson, 2015.

URLs:

1.	
2.	

Lecture Plan (about 40-50 Lectures):

Lecture No.	Topic
1.	Review of Digital Image Processing
2.	Image Formation
3.	Image Models I
4.	Image Models I
5.	Radiometry
6.	Shadows and Shading
7.	Color Cameras
8.	Segmentation and Fitting
9.	Tracking with Linear Dynamic Models I
10.	Tracking with Linear Dynamic Models II
11.	Correspondence and Pose
12.	Registration inImaging Systems I
13.	Registration inImaging Systems II
14.	Pattern Definition
15.	Types of Pattern
16.	Pattern Recognition System
17.	Components of Pattern Recognition Syatem
18.	Bayesian Decision Theory
19.	Bayesian Networks
20.	Bayesian Estimation
21.	Bayes Error
22.	Maximum Likelihood Estimation I
23.	Maximum Likelihood Estimation II
24.	Dimensionality Reduction
25.	Feature Selection
26.	Linear Discriminant Functions
27.	Nearest Neighbour based Classifiers I
28.	Nearest Neighbour based Classifiers II
29.	Decision Tree Based Classifiers I
30.	Decision Tree Based Classifiers II
31.	Support Vector Machines (SVMs) I
32.	Support Vector Machines (SVMs) II
33.	Expectation-Maximization (EM) Algorithm I
34.	Expectation-Maximization (EM) AlgorithmII
35.	Non-parametric Estimation I
36.	Non-parametric Estimation II
37.	Class Histograms
38.	ClassifierBuilding
39.	Artificial Neural NetworksI
40.	Artificial Neural Networks II

Name of Program	B.Tech	Semester V/VI/VII/VIII	Year $3^{rd}/4^{th}$
Name of Course	Mobile Communication		
Course Code	ECE 460		
Core / Elective / Other	**Elective**		

Prerequisite:	
1.	Antenna and Microwave Engineering
2.	Concept of communication Engineering
3.	Network Theorems and Algorithms.
Course Outcomes:	
1.	CO1: Explain the different types of mobile communication network model.
2.	CO2: Classify the channel assignment and frequency reuse concept for mobile communications.
3.	CO3: Analyze different routing algorithms and methods to improve QOS.
4.	CO4: Summarize the attenuation of wave propagation.
5.	CO5: Describe various application of GSM Technology 3G ,4G, 5G etc.
Description of Contents in brief:	
1.	Concepts of cellular communication, System design fundamentals,
2.	Geometry of hexagonal cells
3.	Co-channel interference, Cell splitting, Frequency allocation in mobile, Handoff Frequency Reuse
4.	Mobile radio wave propagation; reflection, diffraction, fading. Path loss prediction. Multipath propagation.
5.	Statistical characterization of multipath fading. Diversity .Link design. Design parameters for base station.
6.	Antenna location, spacing, heights and configurations. Multiple access techniques; FDMA, TDMA and CDMA. Spread spectrum.
7.	Power control. WCDMA. CDMA network design. GSM. 3G systems. WLAN technology. WLL. Hiper LAN. Ad hoc networks. Bluetooth. OFDM and MC-CDMA, Wi-MAX, LTE, Study on radiation hazards.
List of Text Books:	
1.	Wireless Communication Principles T.S.Rappaport
2.	Mobile Communication Engineering W.C.Y.Lee,
3.	Wireless Communications A.F.Molisch
List of Reference Books:	
1.	Principles of Mobile Communications G.L. Stuber
2.	Wireless Communications Andrea Golsmith
URLs:	
Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**

1.	Concepts of cellular communication
2.	----------do----------
3	----------do----------
4	----------do----------
5	System design fundamentals,
6	----------do----------
7	----------do----------
8	Geometry of hexagonal cells
9	----------do----------
10	----------do----------
11	Co-channel interference, Cell splitting
12	----------do----------
13	Cell splitting, Frequency allocation in mobile,
14	----------do----------
15	----------do----------
16	Handoff Frequency Reuse
17	----------do----------
18	----------do----------
19	Mobile radio wave propagation; reflection, diffraction, fading
20	----------do----------
21	----------do----------
22	Path loss prediction. Multipath propagation.
23	----------do----------
24	----------do----------
25	Statistical characterization of multipath fading. Diversity .Link design
26	----------do----------
27	----------do----------
28	Design parameters for base station.
29	----------do----------
30	----------do----------
31	Antenna location, spacing, heights and configurations
32	----------do----------
33	----------do----------
34	Multiple access techniques; FDMA, TDMA and CDMA. Spread spectrum.
34	----------do----------
36	----------do----------
37	----------do----------
38	Power control. WCDMA. CDMA network design
39	----------do----------
40	----------do----------
41	GSM. 3G systems. WLAN technology. WLL.
42	----------do----------
43	Hiper LAN. Ad hoc networks. Bluetooth. OFDM and MC-CDMA, Wi-MAX, LTE, Study on radiation hazards.
44	----------do----------
45	----------do----------

Name of Program	B. Tech.	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	**Radar and Navigation Systems**		
Course Code	ECE 461		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Fundamental knowledge of electronics, electromagnetic
2.	Antenna and wave propagation
3.	Analog Communication
Course Outcomes:	
1.	basic radar system and its range performance
2.	Describe MTI and other radar system.
3.	Explain about various types of advanced navigation systems
Description of Contents in brief:	
1.	The simple form of Radar Equation, Radar Block diagram and Operation, Radar Frequencies, millimetre and submillimetre waves, Applications of Radar.
2.	Introduction, Delay line Cancellers, Multiple or staggered Pulse Repetition Frequencies, Range gated Doppler Filters,
3.	Example of MTI radar Processor, , Pulse Doppler Radar, Non coherent MTI ,MTI from moving platform, Other types of MTI
4.	Doppler navigation-Doppler Effect, New configuration, Doppler frequency equations, Track stabilization
5.	Doppler navigation system , GPS principle of operation, Position location determination
6.	Radar Transmitters and Receivers, Receiver noise Figure, RadarDisplays. Radio Direction Finder, An Aural Null Direction Finder, The Goniometer, AdcockDirection finder, Errors in Direction Finding.
List of Text Books:	
1.	Skolnik, M., "Introduction to Radar Systems", Tata McGraw-Hill
2.	N.S.Nagaraja, "Elements of Electronic Navigation Systems", Tata McGraw-Hill
3.	G S N Raju ,"Radar Engineering and Fundamentals of Navigational Aids" IK International Publishers,
List of Reference Books:	
1.	Peyton Z. Peebles:, "Radar Principles", John Wiley
2.	J.C Toomay, " Principles of Radar", 2nd Edition –PHI
3.	Slater, J.M. Donnel, C.F.O and others, "Inertial Navigation Analysis and Design", McGrawHill Book Company, New York
URLs:	
1.	http://nptel.iitm.ac.in/courses.php?branch=Ece
2.	http://www.radartutorial.eu/07.waves/wa04.en.html

3.	https://ocw.mit.edu/resources/res-ll-001-introduction-to-radar-systems

Lecture Plan (about 40-50 Lectures):

Lecture No.	Topic
1	Introduction to Radar, Radar Equation
2	Radar Block Diagram, Radar Frequencies,Applications of Radar.Integration of Radar Pulses
3	Radar Cross Section of Targets,Transmitter Power
4	Pulse Repetition Frequency
5	Radar system losses
6	Introduction to Doppler and MTI Radar
7	Delay Line Cancellers
8	Staggered Pulse Repetition
9	Frequencies,Doppler Filter Banks
10	Digital MTI Processing
11	Moving TargetDetector
12	Limitations to MTI Performance
13	MTI from a Moving Platform (AMIT) – Pulse Doppler Radar
14	Tracking with Radar –Monopulse Tracking
15	Conical Scan and Sequential Lobing
16	Limitations to Tracking Accuracy
17	Low-Angle Tracking
18	Tracking Range
19	Comparison of Trackers
20	Automatic Tracking with Surveillance Radars (ADT).
21	The Radar Antenna
22	Reflector Antennas
23	Electronically Steered Phased Array Antennas
24	Phase Shifters
25	Frequency-Scan Arrays.
26	Radar Transmitters and Receivers

27	Receiver noise Figure
28	RadarDisplays.
29	Radio Direction Finder
30	An Aural Null Direction Finder
31	The Goniometer
32	Adcock Direction finder
33	Hyperbolic Systems of Navigation (Loran and Decca),
34	Hyperbolic Systems of Navigation Decca
35	Loran-A ,Loran-A Equipment
36	Range and precision of Standard Loran, Loran-C
37	The Decca Navigation System Decca Receivers
38	Range and Accuracy of Decca
39	DME and TACAN – Distance Measuring Equipment
40	Operation of DME – TACAN Equipments
41	Satellite Navigation System
42	NavstarGlobal Positioning System (GPS)

Name of Program	B.Tech	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	**Video Signal Processing**		
Course Code	ECE 462		
Core / Elective / Other	**Elective**		

Prerequisite:	
1.	Higher engineering mathematics
2.	Fundamental knowledge of signal processing
3.	Fourier analysis (all signal processing relates to Fourier analysis in some form or another)
Course Outcomes:	
1.	learn the basic principles and tools used to process videos, and how to apply them in solving practical problems of commercial and scientific interests.
2.	Understand different methods, models for video processing and motion estimation.
3.	Apply quantitative models of image and video processing for various engineering applications and develop innovative design for practical applications in various fields.
Description of Contents in brief:	
1.	Basics of Video, Analog Video signal, Composite video signal, Video Formation, Horizontal and vertical synchronization, Spatial and Temporal resolution
2.	Video signal standards: NTSC, SECAM, PAL, Video signal BW requirement, Digital Video Processing, Analysis and synthesis of Video Signal,
3.	Colour Signal Generation and coding, Video display, Video camera, Video Coding
4.	Motion Analysis and Motion Compensation, Motion compensated filtering, Motion Estimation techniques
5.	Optical flow methods, Block based methods, Bayesian method, Video Coding standards,
6.	Video compression standards: H2.61, MPEG 1, MPEG 2
List of Text Books:	
1.	M. Parker, s. Dhanani "Digital Video Processing for Engineers: A Foundation for Embedded Systems Design", Newnes
2.	Vijay Madisetti "Video, Speech, and Audio Signal Processing and Associated Standards" 1st Edition CRC press.
3.	King N. Ngan, Chi W. Yap, Keng T. Tan "Video Coding for Wireless Communication Systems" CRC press
List of Reference Books:	
1.	A M Tekalp, "Digital Video Processing", PH Publication.
2.	Y Q. Shi, H Sun, "Image and Video Compression for Multimedia Engineering", CRC Press.
3.	J W Woods, "Multi-Dimensional, Signal, Image and Video Processing and Coding" Academic Press.
URLs:	
1.	https://www.oreilly.com/library/view/digital-video-processing/9780133991116/

2.	https://www.crcpress.com/Image-and-Video-Compression-for-Multimedia-Engineering-Fundamentals-Algorithms/Shi-Sun/p/book/9780849373640
3.	https://www.elsevier.com/books/multidimensional-signal-image-and-video-processing-and-coding/woods/978-0-12-381420-3

Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**
1.	Basics of Video
2.	Analog Video signal
3.	Composite video signal
4.	Video Formation
5.	Horizontal synchronization
6.	Vertical synchronization
7.	Spatial resolution
8.	Temporal resolution
9.	Video signal standards
10.	NTSC
11.	SECAM
12.	PAL
13.	Video signal BW requirement
14.	Digital Video Processing
15.	Analysis and synthesis of Video Signal
16.	Colour Signal Generation and coding
17.	Digital Video Signals and Formats
18.	Video Compression Techniques: Entropy and Predictive coding
19.	Block Transform Coding
2.	Quantization
21.	MC and Estimation Transform Coding
22.	Video display
23.	Video camera
24.	Video Coding
25.	Motion Analysis
26.	Notation and Preliminaries: Binary Hypothesis Testing
27.	Markov Random Fields
28.	MAP Estimation and Variational Formulation
29.	Motion Detection: Hypothesis Testing with Fixed and AdaptiveThreshold
30.	MAP MRF Formulation
31.	MAP Variation Formulation
32.	Experimental Comparison of Motion Detection Methods 6 15 Motion Estimation
33.	Motion Models and Estimation Criteria
34.	Search Strategies Practical Motion Estimation Algorithms
35.	Global Motion Estimation
36.	Block Matching and Phase Correlation
37.	Optical Flow via Regularization
38.	MAP Estimation of Dense Motion
39.	Motion Compensation
40.	Motion compensated filtering
41.	Motion Estimation techniques

42.	Optical flow methods
43.	Block based methods
44.	Bayesian method
45.	Video Coding standards
46.	Video compression standards: H2.61
47.	Video structure and bit-stream
48.	Scalable coding
49.	Data partitioning
50.	Comparison of MPEG-1 and MPEG-2

Name of Program	BTech	**Semester V/VI/VII/VIII**	**Year** 3rd/4th

Name of Course	**Advanced Instrumentation**
Course Code	ECE 463
Core / Elective / Other	**Elective**

Prerequisite:	
1.	Electronic Instrumentation and Measurement, Electronic Circuits
Course Outcomes:	
1.	Introduce students to the major ideas, methods, and techniques of Advanced Instrumentation.
2.	To demonstrate the fundamentals and techniques of Measurements.
3.	To make students familiar with various issues in the design of Instrumentation System
4.	Students will be able to understand various instrument interfaces.
5.	Students will be able to develop domain specific virtual instrumentation system.
Description of Contents in brief:	
1.	Conductivity measurement. Smart sensors-block diagram, Smart transmitter. Recent trends in sensor technology – Semiconductor sensors–Film sensors-MEMS-Nanosensors. Voltage, Time, Phase measurement using digital techniques –Input circuits of digital voltmeter–auto zero circuit–bipolar operation–buffer circuit–protection–auto ranging–tracking method. Ratiometric Measurements-Applications–Measurement of modulation index, Q of a coil Noise in instrumentation systems, electromagnetic interference, methods of noise coupling, noise sources, grounding. Virtual Instrumentation–concepts–historical perspective–virtual versus real instrumentation–advantages of virtual instrumentation–block diagram and architecture of a virtual instrument–Physical quantities and analog interfaces– Hardware and software–User Interfaces–Applications of virtual instrumentation. Common Instrument Interfaces – RS232C, RS422A, RS 432A, RS485A, USB, General Purpose Interface Bus (GPIB), Standard Commands for Programmable Instrumentation (SCPI), VME Extensions for Instrumentation (VXI), Multisystem Extension Interface (MXIbus), Enhanced Parallel Port. Virtual Instrument Software Architecture
List of Text Books:	
1.	D. Patranabis, Principles of Industrial Instrumentation, 2nd ed., Tata McGraw Hill, New Delhi, 1996
2.	T. S. Rathore, Digital Measurement Techniques, 2nd ed., Narosa Publishing House, New Delhi, 2004
List of Reference Books:	
1.	G. W. Johnson, LabVIEW Graphical Programming: Practical Application in Instrumentation and Control, 2nd ed., McGraw Hill, New York, 1997.
2.	H. R. Taylor, Data Acquisition for Sensor Systems, Chapman & Hall, London, 1992
3.	J. Y. Beyon, Hands-On Exercise Manual for LabVIEW Programming, Data Acquisition and
URLs:	
Lecture Plan (about 40-50 Lectures):	

Lecture No.	Topic
1.	Conductivity measurement
2.	Smart sensors-block diagram
3.	Smart transmitter
4.	Recent trends in sensor technology
5.	Semiconductor sensors
6.	Film-sensors
7.	MEMS
8.	Nanosensors
9.	Input circuits of digital voltmeter
10.	Auto zero circuit
11.	Bipolar operation
12.	Buffer circuit
13.	Protections
14.	Auto ranging
15.	Tracking method
16.	Voltage measurement using digital techniques
17.	Timemeasurement using digital techniques
18.	Phase measurement using digital techniques
19.	Ratiometric Measurements
20.	Applications of Ratiometric Measurements
21.	Measurement of modulation index
22.	Measurement of modulation index
23.	Q of a coil
24.	Noise in instrumentation systems
25.	Electromagnetic interference
26.	Methods of noise coupling
27.	Noise sources
28.	Grounding
29.	Virtual Instrumentationconcepts
30.	Historical perspective
31.	Virtual versus real instrumentation
32.	Advantages of virtual instrumentation
33.	Block diagram of virtual instrument
34.	Architecture of virtual instrument
35.	Physical quantities
36.	analog interfaces
37.	Hardware and software–User Interfaces
38.	Applications of virtual instrumentation
39.	Common Instrument Interfaces – RS232C, RS422A, RS 432A, RS485A, USB,
40.	General PurposeInterface Bus (GPIB)
41.	Standard Commands for Programmable Instrumentation (SCPI)
42.	VME Extensions for Instrumentation (VXI)
43.	Multisystem Extension Interface (MXIbus)
44.	Enhanced Parallel Port
45.	Virtual Instrument Software Architecture

Name of Program	B.Tech.	**Semester V/VI/VII/VIII**	**Year** 3rd/4th
Name of Course	Multirate Signal Processing		
Course Code	ECE 464		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Fundamental knowledge of Communication systems
2.	Basic knowledge of Signals and Systems
3.	Fundamental knowledge of Digital Signal Processing
Course Outcomes:	
1.	Introduces multirate digital signal processing along with different forms of filter bank applications.
2.	Homomorphic signals and systems are discussed with cepstral analysis.
3.	Different types of adaptive filters with its application are elaborated.
Description of Contents in brief:	
1.	**Adaptive filtering:** Principle of Adaptive filters, Tapped delay Line and Weiner filters, Steepest Descent Algorithm, Least Mean Square (LMS) Algorithm, Direct Least Square and Recursive Least Square (RLS) Algorithms
2.	**Application of Adaptive filters**: Noise canceller, Echo canceller, Side Lobe Canceller, Adaptive Line Enhancer.
3.	**Multi-rate Signal Processing:** Multi-rate Systems, Decimation and Interpolation (integer and fractional), Decimation Filters, Interpolation File
4.	M-channel perfect reconstruction filter banks
5.	Cosine Modulated filterbanks. Polyphase structure- PR Systems.
List of Text Books:	
1.	P.P. Vaidyanathan. “Multirate systems and filter banks.” Prentice Hall. PTR.
2.	N.J. Fliege. “Multirate digital signal processing .” John Wiley
3.	Sanjit K. Mitra. “ Digital Signal Processing: A computer based approach.” McGraw
List of Reference Books:	
1.	R.E. Crochiere. L. R. “Multirate Digital Signal Processing”, Prentice Hall. Inc.
2.	J.G. Proakis. D.G. Manolakis. “Digital Signal Processing: Principles. Algorithms and Applications”, 3rd Edn. Prentice Hall India
3.	
URLs:	
1.	https://swayam.gov.in/nd1_noc20_ee21/preview
2.	https://nptelmooc2013.appspot.com/noc19_ee27/preview

3.	
Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**
1	Signals, Fourier representations, DFT & FFT, IIR and FIR filters
2	Homomorphic system, complex Cepstrum,
3	properties of complex cepstrum, complex cepstrum of exponential signals,
4	Real Cepstrum, Implementation of cepstrum using DFT,
5	Tutorial
6	Hilbert transform relations in cepstral analysis,
7	Hilbert transform relations in cepstral analysis,
8	convolution and deconvolution, Examples of Homomorphic signal
9	Fundamentals of Multirate Theory: The sampling theorem - sampling at sub-Nyquist rate
10	Fundamentals of Multirate Theory: The sampling theorem - sampling at sub-Nyquist rate
11	Basic Formulations and schemes - Basic Multirate operations
12	Basic Formulations and schemes - Basic Multirate operations
13	Tutorial
14	Decimation and Interpolation - Digital Filter Banks- DFT Filter Bank- Identities
15	Decimation and Interpolation - Digital Filter Banks- DFT Filter Bank- Identities
16	Polyphase representation - Maximally decimated filter banks: Polyphase representation
17	Polyphase representation - Maximally decimated filter banks: Polyphase representation
18	Errors in the QMF bank- Perfect Reconstruction (PR) QMF Bank
19	Errors in the QMF bank- Perfect Reconstruction (PR) QMF Bank
20	Design of an alias free QMF Bank
21	Design of an alias free QMF Bank
22	Tutorial
23	M-channel perfect reconstruction filter banks: tree structured filter bank
24	M-channel perfect reconstruction filter banks: tree structured filter bank
25	Uniform band and non uniform filter bank
26	Uniform band and non uniform filter bank
27	Errors created by filter bank system
28	Errors created by filter bank system
29	Tutorial
30	Polyphase representation- perfect reconstruction systems
31	Polyphase representation- perfect reconstruction systems
32	Perfect reconstruction (PR) filter banks: Two channel FIR paraunitary QMF Bank
33	Para-unitary PR Filter Banks
34	Para-unitary PR Filter Banks
35	Tutorial
36	Filter Bank Properties induced by paraunitarity
37	Filter Bank Properties induced by paraunitarity fix to prefix conversion

38	Linear phase PR Filter banks- Necessary conditions for Linear phase property
39	Linear phase PR Filter banks- Necessary conditions for Linear phase property
40	Linear phase PR Filter banks- Necessary conditions for Linear phase property
41	Tutorial
42	Principle of Adaptive filters,
43	Tapped delay Line and Weiner filters
44	Steepest Descent Algorithm, Least Mean Square (LMS) Algorithm
45	Direct Least Square and Recursive Least Square (RLS) Algorithms

Name of Program	B. Tech	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	Micro Electro Mechanical Systems		
Course Code	ECE 465		
Core / Elective / Other	Elective		

Prerequisite:

1.	The students are well versed with the fundamentals of Material Science.

Course Outcomes:

1.	Students will explain MEMS Technology, Present, Future and Challenges.
2.	Students will be able to explain micro sensors, micro-actuators, their types and applications.
3.	Students will be able to explain about fabrication processes for producing micro-sensors and actuators. They will also be able to apply Reliability, and Failure Analysis Testing.

Description of Contents in brief:

1.	Introduction, Development of MEMS Technology, Present, Future and Challenges, Fabrication Processes: Fundamentals of Material Science, Substrates: Single crystal substrates, Silicon on Insulator Substrate, Physical vapour deposition, Chemical vapour Deposition, Etching Processes, patterning, wafer bonding, annealing, chemical mechanical polishing, material doping, MEMS application in life sciences.
2.	Principal of Microsystems: Introduction, Microsensors and there types, Microactuation using different forces and materials, Microactuators and there types, Microaccelerometers, Microfluidics Scaling Laws in Miniatuarization: Introduction to scaling, Scaling of physical systems scaling (geometric, mechanical, thermal, fludic, electrical, optical and chemical and biological), computational fabrication, and material issues Materials and Microsystems: Introduction, Substrates and wafers, active substrate materials, Silicon as a substrate material, Silicon compounds, silicon piezoresistors, Gallium Arsenide, Quarta, Piezoelectric crystals, polymers, packaging materials.
3.	Microsystem Fabrication Process and Manufacturing: Introduction, Photolithography, Ion implantation, Diffusion, Oxidation, Chemical vapour deposition, physical vapour deposition, Chemical Mechanical Polishing, Material Doping, Deposition of epitaxy, Etching, Patterning, wafer-bonding and annealing. Micromanufacturing: Bulk micromachining, Surface micromachining, LIGA, Packaging and Reliability: Packaging process steps, reliability models, MEMS failure mechanisms, Measurement Techniques for MEMS Operational, Reliability, and Failure Analysis Testing.

List of Text Books:

1.	Tai-Ran Hsu, MEMS & Microsystems Design and Manufacture, Fourth reprint edition, 2012.
2.	Allen James J, Micro Electromechanical System Design, First edition, Taylor and Farancis, FL (USA), 2005.

3.	MalufNadim and Williams Kirt, An Introduction to Microelectromechanical Systems Engineering, Second Edition, ARTECH House, MA (USA), 2004.

List of Reference Books:

1.	N. Maluf," An Introduction to Micro-electro Mechanical System Engineering", Artech. House.
2.	S. Senturia," Micro system Design", Springer.

Lecture Plan (about 40-50 Lectures):

Lecture No.	Topic
1.	Introduction, Development of MEMS Technology, Present, Future and Challenges.
2.	Fabrication Processes: Fundamentals of Material Science.
3.	Substrates: Single crystal substrates.
4.	Silicon on Insulator Substrate.
5.	Physical vapour deposition.
6.	Chemical vapour Deposition.
7.	Etching Processes.
8.	Patterning.
9.	Wafer bonding.
10.	Annealing.
11.	Chemical mechanical polishing.
12.	Material doping.
13.	MEMS application in life sciences.
14.	Principal of Microsystems: Introduction, Microsensors and there types.
15.	Microactuation using different forces and materials.
16.	Microactuators and there types
17.	Microaccelerometers.
18.	Microfluidics Scaling Laws in Miniatuarization: Introduction to scaling.
19.	Scaling of physical systems scaling (geometric, mechanical, thermal, fludic, electrical, optical and chemical and biological).
20.	Computational fabrication.
21.	Material issues Materials and Microsystems: Introduction.
22.	Substrates and wafers.
23.	Active substrate materials.
24.	Silicon as a substrate material, Silicon compounds.
25.	Silicon piezoresistors.
26.	Gallium Arsenide, Quartz, Piezoelectric crystals.
27.	Polymers, packaging materials.
28.	Microsystem Fabrication Process and Manufacturing: Introduction.
29.	Photolithography.
30.	Ion implantation.
31.	Diffusion.
32.	Oxidation
33.	Chemical vapour deposition, physical vapour deposition,
34.	Chemical Mechanical Polishing.
35.	Material Doping.
36.	Deposition of epitaxy.

37.	Etching.
38.	Patterning.
39.	Wafer-bonding and annealing.
40.	Micromanufacturing: Bulk micromachining.
41.	Surface micromachining.
42.	LIGA.
43.	Packaging and Reliability: Packaging process steps.
44.	Reliability models.
45.	MEMS failure mechanisms.
46.	Measurement Techniques for MEMS Operational.
47.	Reliability and Failure Analysis Testing.

Name of Program	B Tech	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	Statistical Signal Processing		
Course Code	ECE 466		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Probability ,
2.	Basic signal, system, signal analysis technique
3.	Statistical analysis techniques
Course Outcomes:	
1.	Understanding of autoregressive, moving average, autoregressive moving average, and general linear models and how they are related.
2.	Ability to apply nonparametric techniques to estimate autocorrelation, cross-correlation, and partial correlation, Ability to characterize an estimator.
3.	Ability to conduct and present a peer-reviewed research project orally and in written form
Description of Contents in brief:	
1.	Random variables and Moments, Moment generating function, Random Vector, Nonstationary signal analysis, Random Processes: Definition and Classification, Stochastic integrals, Stationary and Non-stationary processes, Ergodicity, Correlation functions. Special random processes (white Gaussian noise, Wiener-Levy processes, shot-noise processes, Optimum Filtering: Matched filters, Wiener filters for random signals in white and colored Gaussian noise, Discrete and continuous time filters, Kalman filter and its application, Power spectrum estimation, Wiener, Adaptive Filtering, Wavelet Analysis. Power Spectrum Estimation, Least square Lattice filters, Signal Analysis with Higher order Spectra, Array processing, Beam-forming, Time-delay estimation. Parametric and Non parametric estimation, Power Spectrum Estimation-Parametric and Maximum Entropy Methods, Levinson-Durban Algorithms Least Square Method, MLE, Cholesky decomposition, LDU-OR, SV decomposition.
List of Text Books:	
1.	Statistical Digital Signal Processing and Modelling M. Hays, John Willey and Sons, 1996.
2.	Statistical Signal Processing with Applications M.D. Srinath, P.K. Rajasekaran and R. Viswanathan
3.	
List of Reference Books:	
1.	Detection, Estimation and Modulation, H.L. Van Trees,
2.	
3.	
URLs: Nil	
1.	

2.	
3.	

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**

1. Discrete-Time Processing:
2. Discrete-Time Systems:
3. Random Variables:
4. Stochastic Signals:
5. Estimation Theory:
6. Signal Models [2lect]:
7. Autocorrelation:
8. Windowing:
9. Spectral Estimation:
10. Joint Signal Analysis:
11. Coherence Analysis:
12. Time-Frequency Analysis:
13. Linear Estimation:
14. Optimum FIR Filters:
15. Linear Prediction:
16. Optimum IIR Filters:
17. Optimum Linear Filter Applications[2 lect]:
18. Order-Recursive Algorithms[2 lect]:
19. Innovations:
20. State Space Models[2 lect]:
21. Kalman Filter:
22. Extended Kalman Filter:
23. Least-Squares Estimation[2 lect]:
24. Practical Modeling[2 lect]:
25. Autoregressive Models[2 lect]:
26. Pole-Zero Models
27. Minimum-Variance Spectrum Estimation[2lect]
28. Frequency Estimation [2lect]

Name of Program	BTech	**Semester V/VI/VII/VIII**	**Year** 3rd/4th
Name of Course	**Biomedical Signal Processing**		
Course Code	ECE 467		
Core / Elective / Other	**Elective**		

Prerequisite:	
1.	Digital Image Processing, Digital Signal Processing
Course Outcomes:	
1.	Introduce students to the major medical signal modelities and their acquisition system.
2.	To demonstrate the various signal processing techniques of medical signals.
3.	To make students familiar with various medical signal analysis metho .
4.	Students will be able to develop signal processing algorithms for enhancement, denoising, compression.
5.	Students will be able to develop domain specific medical signal classification models for computer aided diagnosis.
Description of Contents in brief:	
1.	Biomedical Signals
2.	Biomedical Signal Acquisition Systems
3.	Medical Signal formats
4.	Medical Signal Processing
5.	Medical SignalAnalysis
6.	Computer aided diagnosis
List of Text Books:	
1.	Biomedical Signal and Image Processing, KayvanNajarian, Robert Splinter, CRC Press, 2016
2.	Medical Imaging Signals and Systems, Jerry L. Prince, Jonathan Links, 4th Edition, Pearson, 2015.
List of Reference Books:	
1.	Biomedical Image Processing, Thomas M. Deserno, Springer Science & Business Media, 2011
2.	Biomedical Signal Analysis, Rangaraj M. Rangayyan, John Wiley and Sons, 2015
3.	Medical image processing, G.R. Sinha, BhagwatiCharan Patel, 1st Edition, PHI, 2014.
4.	Machine Learning, SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, 1st Edition, Pearson, 2018.
5.	Artificial Intelligence: A Modern Approach, Stuart J. Russell and Peter Norvig, 3rd Edition, Pearson, 2015.
URLs:	
1.	

Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**
1.	Review of Digital Image Processing
2.	Review of Digital Signal Processing
3.	Introduction to biomedical Signals

4.	Radiographic Images
5.	Radiographic ImageAcqusition System
6.	Enhancement, Restoration, Segmentation and compression of medical Signals.
7.	TomographicImages
8.	Tomographic Image Acqusition System
9.	Tomographic Image reconstruction
10.	Magnetic Resonance Images
11.	Magnetic ResonanceAcqusition System
12.	Magnetic Resonance Reconstruction
13.	Ultrasound Images
14.	Ultrasound Image Acqusition System
15.	Medical Image formats I
16.	Medical Image formats II
17.	Enhancement of Medical signals
18.	Compression of Medical signals
19.	Denoising of Medical signals
20.	Statistical measurement based signal processing systems I
21.	Statistical measurement based signal processing systems II
22.	Feature extraction
23.	Medical signal processing in spatial domain I
24.	Medical signal processing in spatial domain II
25.	Medical signal processing in spatial domain III
26.	Medical signal processing in frequency domain I
27.	Medical signal processing in frequency domain II
28.	Medical signal processing in frequency domain III
29.	Texture based analysis I
30.	Texture based analysis II
31.	Shape based analysis I
32.	Shape based analysis II
33.	Object detection and extraction I
34.	Object detection and extraction II
35.	Computer aided diagnostic techniques I
36.	Computer aided diagnostic techniques II
37.	Computer aided diagnostic techniques III
38.	Classification of medical signals I
39.	Classification of medical signals II
40.	Classification of medical signals III

Name of Program	B.Tech	**Semester V/VI/VII/VIII**	**Year** $3^{rd}/4^{th}$
Name of Course	Fuzzy Logic		
Course Code	ECE 468		
Core / Elective / Other	Elective		

Prerequisite:	
1.	Elementary Set Theory(M3)
2.	Elementary Probability Theory(M3)
3.	

Course Outcomes:

1.	Learning concepts of Fuzzy Set Theory and Fuzzy Logic.
2.	Gaining knowledge about Fuzzy rule base systems and performance analysis
3.	Formulating and solving various real life problems using concepts of Fuzzy logic.

Description of Contents in brief:

1.	Classical Set and Fuzzy set Theory
2.	Classical and Fuzzy Relations
3.	Fuzzification and Defuzzifications
4.	Development of Membership function
5.	Fuzzy Logic and Fuzzy Systems
6.	Decision Making with Fuzzy Information
7.	Fuzzy Classification
8.	Fuzzy Pattern Recognition
9.	Fuzzy Control Systems
10.	Miscellaneous Topics

List of Text Books:

1.	Timothy J. Ross, Fuzzy Logic With Engineering Applications, 3^{rd} ed. Wiley, 2010
2.	George J Klir / Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Pearson, 2015
3.	A.K. Bhargava, Fuzzy Set Theory Fuzzy Logic and their Applications, S.Chand and Comp, 2013

List of Reference Books:

1.	LotfiA.Zadeh and Rafik A. Aliev, Fuzzy Logic theory and Applications, World Scientific, 2018.
2.	M.K. Hasan, Fuzzy Sets and Fuzzy Logic with Applications: Imprecision, Uncertainty and Vagueness, Scholar's Press, 2019
3.	Hans-Jurgen Zimmermann, Practical Applications of Fuzzy Technologies (The Handbooks of Fuzzy Sets), 2012, Springer Science

URLs:

1.	https://www.tutorialspoint.com › fuzzy_logic
2.	https://www.guru99.com/
3.	https://www.youtube.com/watch?v=a2i-lHS-c_I

Lecture Plan (about 40-50 Lectures):

Lecture No.	Topic
1.	Introduction and historical aspects of Fuzzy set theory
2.	Classical set theory and Fuzzy set theory
3.	Fuzzy membership functions
4.	Fuzzy union, intersection and complement operations
5.	Graphical representations of Fuzzy operations
6.	Cartesian product and Fuzzy Relations
7.	Fuzzy Compositions
8.	Fuzzy equivalence Relations
9.	Value assignments for Fuzzy Relations
10.	Fuzzy Set elements and Properties
11.	Concepts of Fuzzification and Defuzzifications
13.	Methods of Defuzzification
14.	Alpha Cut for Crisp conversion
15.	Alpha Cut for Fuzzy Equivalence Relation
16.	Fuzzy Propositions
17.	Fuzzy Implications
18.	Concepts of Fuzzy Rule based Systems
19.	Mamdani Fuzzy Rule based Systems
20.	Sugeno (TSK) Fuzzy Rule based Systems
21.	Tsukamoto Fuzzy Rule based Systems
22.	Development of Fuzzy membership functions
23.	Intuition and Inference method
24.	Rank ordering and Neural network method
25.	Other methods for development of Fuzzy membership functions
26.	Fuzzy Decision Masking
27.	Fuzzy Ordering
28.	Nontransitive Ranking
29.	Preference and Consensus
30.	Multiobjective Decision Making: Concepts and Requirements
31.	Multiobjective Decision Making: Examples
32.	Multiobjective Decision Making: Practical Applications
33.	Fuzzy Bayesian Decision Making: Concepts and requirements
34.	Fuzzy Bayesian Decision Making: Examples
35.	Decision Making Under Fuzzy States
36.	Fuzzy Classification
37.	Fuzzy Clustering
38.	Fuzzy C-Means Clustering
39.	Fuzzy C-Means Clustering (Cont.)
40.	Hard C-Means and Fuzzy C-Means Algorithms

41.	Fuzzy pattern Recognition
42.	Feature Analysis
43.	Single Sample Identification
44.	Multi Feature Pattern Recognition
45.	Fuzzy Extension Principles
46.	Approximate Methods of Fuzzy Extension
47.	Fuzzy control Systems
48.	Simple Fuzzy Logic Controllers
49.	Fuzzy Logic Controllers (Cont.)
50.	Industrial Applications

Name of Program	B.Tech	**Semester V/VI/VII/VIII**	**Year** 3rd/4th
Name of Course	Neural Networks		
Course Code	ECE 469		
Core / Elective / Other	Elective		

Prerequisite:	
1.	-
2.	-
3.	--
Course Outcomes:	
1.	Learning concepts of Neural Networks.
2.	Gaining knowledge about Neural Networks based systems
3.	Formulating and solving various real life problems using concepts of ANN.
Description of Contents in brief:	
1.	Introduction to ANN
2.	Artificial Neurons architecures
3.	Learning Algorithms
4.	Neural Network Architectures
5.	Feed forward and Fee Back Neural Networks
6.	Self Organizing Feature Maps (SOM)
7.	Concepts of Machine Learning
8.	Convolutional Neural Networks
9.	Applications of CNN
10.	Miscellaneous Topics
List of Text Books:	
1.	Simon Haykin, " Neural Networks: A Comprehensive Foundations", MacMillan Publishing Company, 1994
2.	Satish Kumar, "Neural Networks: A Classroom Approach", McGraw Hill Education, 2004
3.	Mohamad Hassoun, "Fundamentals of Artificial Neural Networks", MIT Press, 2003
List of Reference Books:	
1.	Tariq Rashid, "Make Your Own Neural Network: A Gentle Journey Through the Mathematics of Neural Networks" Kindle, 2016.
2.	Wolfgang Beer**, "**Applied Artificial Intelligence: Neural networks and deep learning with Python and Tensor Flow", Kindle, 2017**.**
3.	P.J. Braspenning, "Artificial Neural Networks: An Introduction to ANN Theory and Practice", Springer 1995.
URLs:	
1.	https://www.coursera.org/learn/neural-networks-deep-learning
2.	https://www.coursera.org/learn/machine-learning

3.	https://www.edx.org/learn/neural-network

Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**
1.	Introduction and historical aspects of Neural Networks
2.	Components of biological Neurons
3.	Artificial Neuron Models
4.	Aggregation Functions
5.	Activation Functions
6.	Errors and error functions
7.	Concept and importance of learning rate
8.	Concepts of Learning methods
9.	Supervised Learning Methods
10.	Supervised Learning Methods (Cont.)
11.	Supervised Learning Methods (Cont.)
13.	Unsupervised Learning Methods
14.	Unsupervised Learning Methods (Cont.)
15.	Unsupervised Learning Methods (Cont.)
16.	Reinforcement Learning
17.	Neural network Architectures
18.	Feed Forward Neural Networks
19.	Feed Forward Neural Networks (cont.)
20.	Feed Forward Neural Networks (cont.)
21.	Radial basis Function Neural networks
22.	Radial basis Function Neural networks (Cont.)
23.	Radial basis Function Neural networks (Cont.)
24.	Recurrent Neural Networks
25.	Recurrent Neural Networks (Cont.)
26.	Recurrent Neural Networks (Cont.)
27.	Concepts of Hopfield Neural networks
28.	Hopfield Neural networks (Cont.)
29.	Electrical Equivalence of Hopfield network
30.	Energy function of Hopfield Network
31.	Weight calculation of Hopfield networks
32.	State updating and applications of Hopfield networks
33.	Adaptive Resonance Theory (ART)
34.	Adaptive Resonance Theory (Cont.)
35.	Self Organizing Feature Maps (SOM)
36.	Self Organizing Feature Maps (SOM) (Cont.)
37.	Boltzmann Machine
38.	Restricted Boltzmann Machine (RBM)
39.	Concepts of Deep Learning and Machine learning
40.	Convolutional Neural networks (CNN)
41.	Convolutional Neural networks (CNN) (Cont.)
42.	CNN for Image Processing
43.	Neural network Applications in Communication systems
44.	Neural network Applications in Image Processing
45.	Neural network Applications in Antenna Theory

Name of Program	B. TECH	**Semester V/VI/VII/VIII**	**Year** 3rd/4th

Name of Course	IoT and Applications
Course Code	ECE 470
Core / Elective / Other	**Elective**

Prerequisite:	
1.	Fundamentals of computer network,
2.	wireless sensor network, communication & internet technology
3.	web technology, information security
Course Outcomes:	
1.	CO1 - Understand the concepts of Internet of Things
2.	CO2 - Analyze basic protocols in wireless sensor network
3.	CO3 - Design IoT applications in different domain & be able to analyze their performance
4.	CO – 4 Implement basic IoT applications on embedded platform
Description of Contents in brief:	
1.	Introduction to IoT: M2M to IoT M2M vs IoT, An Architectural Overview, IoT Reference Architecture, Domain specific applications of IoT, Developing IoT solutions Internet of Things Privacy, Security and Governance.
List of Text Books:	
1.	Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
2.	Internet of Things (A Hands-on-Approach), by Vijay Madisetti and ArshdeepBahga, 1st Edition, VPT, 2014.
3.	Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, by Francis daCosta, 1st Edition, Apress Publications
List of Reference Books:	
1.	Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
2.	Internet of Things (A Hands-on-Approach), by Vijay Madisetti and ArshdeepBahga, 1st Edition, VPT, 2014.
3.	Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, by Francis daCosta, 1st Edition, Apress Publications
URLs:	
1.	
2.	
3.	

Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**

1 - 5	**Introduction to IoT** Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs
6-10	**IoT& M2M** Machine to Machine, Difference between IoT and M2M, Software define Network
11-20	**Network & Communication aspects** Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination
21- 28	**Challenges in IoT** Design challenges, Development challenges, Security challenges, Other challenges
29 - 34	**Domain specific applications of IoT** Home automation, Industry applications, Surveillance applications, Other IoT applications
34- 40	**Developing IoTs** Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python

Name of Program	BTECH	Semester V/VI/VII/VIII	Year $3^{rd}/4^{th}$

Name of Course	Internet Technology
Course Code	ECE 471
Core / Elective / Other	**Elective**

Prerequisite:	
1.	Basic knowledge of Computers
2.	Computer architecture
3.	Network security

Course Outcomes:	
1.	To get familiar with basics of the Internet Programming
2.	To acquire knowledge and skills for creation of web site considering both client and server side
3.	To gain ability to develop responsive web applications
4.	To explore different web extensions and web services standards

Description of Contents in brief:	
1.	Internetworking: - Internet reference model and Protocols. Transmissions media, Internet devices: Hub, Switch, Router, Gateway, Border Gateway Protocol, SMTP. Introduction to LAN, WLAN, WiMAX, LTE, IEEE802.xx standards.
2.	Introduction to Servers, Proxy Servers, Client-server interaction, Browser architecture, Search Engine, Online transaction issues. Internet of Things (IOT),
3.	Network Management System:- NMS, OSI network management model, MIT, MIB, ASN.1, SNMP
4.	Introduction to Cloud computing, Voice over IP (VoIP), Remote Access: Telnet, Remote Desktop connection, Assignment: Android Application development.

List of Text Books:	
1.	Computer Networks and Internet, 4th Edition D.E.Comer
2.	Internet Technologies, Applications and Societal Impact WojciechCellary, ArunIyengar

List of Reference Books:	
1.	Internet and World Wide Web" 4th edition Paul J. Deitel, Harvey M. Deitel
2.	Network Management: Principles and Practice Mani Subramanian

URLs:	
1.	https://www.scss.tcd.ie/owen.conlan/CS7062/1_Web_Technologies_Handout.pdf
2.	http://www.ddegjust.ac.in/studymaterial/msc-cs/ms-18.pdf

Lecture Plan (about 40-50 Lectures):

Lecture No.	**Topic**
1.	Internetworking
2.	Internet reference model

3.	Protocols
4.	Transmissions media
5.	Internet devices
6.	Hub, Switch
7.	Tutorial-1
8.	Router
9.	Gateway
10.	Border
11.	Gateway Protocol
12.	SMTP
13.	Tutorial-2
14.	Introduction to LAN, WLAN
15.	WiMAX, LTE
16.	IEEE802.xx standards
17.	Introduction to Servers
18.	Proxy Servers
19.	Client-server interaction
20.	Browser architecture
21.	Search Engine
22.	Online transaction issues
23.	Tutorial-3
24.	Internet of Things (IOT)-1
25.	Internet of Things (IOT)-2
26.	Internet of Things (IOT)-3
27.	Internet of Things (IOT)-4
28.	Network Management System**:**- NMS
29.	OSI network management model
30.	MIT
31.	MIB
32.	ASN.1, SNMP
33.	Introduction to Cloud computing, ,.
34.	Voice over IP (VoIP)
35.	Remote Access
36.	Telnet,
37.	Remote Desktop connection
38.	Assignment: Android Application development
39.	Routing algorithum
40.	Tutorial-4

Name of Program	B.Tech (Electronics & communications)	**Semester V/VI/VII/VIII**	**Year** 3rd/4th
Name of Course	Probability Theory and Random Process		
Course Code	ECE 472		
Core / Elective / Other	**Elective**		

Prerequisite:	
1.	NIL
Course Outcomes: After completion of the course, the students will be able to	
CO1	Understand the concept of probability theory, random variables, and density functions
CO2	Apply the concept of standard density functions for different engineering problems
CO3	Create the probabilistic models for prediction for different types of data related problems including engineering, economical and social data
Description of Contents in brief:	
1.	Fundamentals of probability theory and random processes, axiomatic probability theory; discrete and continuous random variables;
2.	Distribution and density functions and Operations on One Random Variable. Expected value of a random variable, function of a random variable. Inequalities.
3.	Multiple Random Variables and Operations on Multiple Random Variables.
4.	The Stochastic process Concept, Deterministic and Nondeterministic Processes, Statistical Independence and concept of Stationarity: Time Averages and 1 Ergodicity Correlation Functions
5.	Spectral representation; Gaussian processes; Poisson and birth-death processes; Markov chains; random walks, Brownian motion,
List of Text Books:	
1.	Probability Theory and Random Processes by P. Ramesh Babu, TMH 2017
2.	Probability and Random Processes by Palaniammal S, PHI 2011
3.	Probability and Random Processes-Scott Miller, Donald Childers,2Ed,Elsevier,2012
List of Reference Books:	
1.	Probability and Random Processes with Application to Signal Processing - Henry Stark and John W. Woods, Pearson Education, 3rd Edition.
2.	Probability, Random Variables and Stochastic Processes Athanasios Papoulis and S.Unnikrishna Pillai, PHI, 4th Edition, 2002.
3.	Statistical Theory of Communication -S.P. Eugene Xavier, New Age Publications 2003
4.	Probability Methods of Signal and System Analysis- George R. Cooper, Clave D. MC Gillem, Oxford, 3rd Edition, 1999
URLs:	
1.	https://www.youtube.com/watch?v=1uW3qMFA9Ho&list=PLUl4u3cNGP60hI9ATjSFgLZpbNJ7myAg6
2.	https://www.youtube.com/watch?v=soZRfdnkUQg
3.	https://www.youtube.com/watch?v=eDS8MnQMgg0
Lecture Plan (about 40-50 Lectures):	
Lectu	**Topic**

re No.	
1.	Set theory, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces
2.	Events, Probability Definitions and Axioms
3.	Mathematical Model of Experiments, Joint Probability
4.	Conditional Probability, Total Probability
5.	Bayes Theorem, and Independent Events, Bernoulli‘s trials.
6.	Definition of a Random Variable, Conditions for a Function to be a Random Variable
7.	Discrete and Continuous, Mixed Random Variable
8.	Distribution and Density functions, Properties
9.	Binomial and Poisson distributions
10.	Uniform, Exponential Gaussian, Rayleigh distributions
11.	Methods of defining Conditioning Event, Conditional Density function and its properties,
12.	Expected value of a random variable, function of a random variable
13.	Moments about the origin, central moments, variance and skew
14.	Characteristic function, moment generating function, transformations of a random variable,
15.	Monotonic transformations for a continuous random variable, transformations of Discrete random variable
16.	Inequalities, Markov Inequality
17.	Chebyshev Inequality
18.	Multiple Random Variables: Vector Random Variables,
19.	Joint Distribution Function and Properties,
20.	Joint density Function and Properties,
21.	Marginal Distribution and density Functions,
22.	Conditional Distribution and density Functions, Statistical Independence,
23.	Distribution and density functions of Sum of Two or Several Random Variables,
24.	Central Limit Theorem
25.	Expected Value of a Function of Random Variables,
26.	Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions
27.	Jointly Gaussian Random Variables: Two and N Random Variable case
28.	Transformations of Multiple Random Variables
29.	The Stochastic process Concept, Classification of Processes, Deterministic and Nondeterministic Processes,
30.	Distribution and Density Functions, Statistical Independence and concept of Stationarity
31.	First-Order Stationary Processes, SecondOrder and Wide-Sense Stationarity,
32.	Nth-Order and Strict-Sense Stationarity, Time Averages and 1 Ergodicity
33.	Mean-Ergodic Processes, Correlation-Ergodic Processes Autocorrelation Function and Its Properties
34.	Cross-Correlation Function and Its Properties, Covariance Functions and its properties, Gaussian Random Processes.
35.	Mean and Mean-squared value, Autocorrelation, Cross-Correlation Functions.
36.	The Power Spectrum and its Properties, Relationship between Power Spectrum and Autocorrelation Function,
37.	Cross-Power Density Spectrum and Properties
38.	Relationship between Cross-Power Spectrum and Cross-Correlation Function

39.	Power density spectrum of response, cross power spectral density of input and output of a linear system
40.	Gaussian processes; Poisson and birth-death processes; Markov chains; random walks, Brownian motion,

Name of Program	B.Tech (Electronics & communications)	**Semester V/VI/VII/VIII**	**Year** 3rd/4th
Name of Course	Artificial Intelligence and Machine Learning		
Course Code	ECE 473		
Core / Elective / Other	**Elective**		
Prerequisite:			
1.	Basic knowledge of probability		
Course Outcomes: After completion of the course, the students will be able to			
CO1	Devise different machine learning models based on the understanding of AI and types of machine learning (ML).		
CO2	Apply the supervised classification methods to classify data having feature vectors and class labels.		
CO3	Evaluate the performance of classification, regression, dimension reduction, and clustering methodologies for pattern recognition.		
CO4	Create a ML model that learns from training sets, and performs efficiently on test and validation sets.		
Description of Contents in brief:			
1.	Basics of Artificial Intelligence (AI), Machine Learning (ML), and Pattern Recognition, Neural Network, Deep Learning, and Generative Networks. Data Science Introduction. ML design cycle, Types of learning, Classifiers. Standard and multi-dimensional PDFs and PMFs.		
2.	Data acquisition and pre-processing methods. Supervised learning models: KNN, SVM, Decision trees, ANNs etc.		
3.	Bayes Decision theory, Parameter estimation methods, MLE, Dimension reduction methods: PCA and LDA etc.		
4.	Sequential data classification using HMMs and RNNs, Regression analysis: linear, polynomial regression, interpolation and extrapolation.		
5.	Unsupervised learning and clustering, K-means, Hierarchical and other clustering methods, Cluster validation.		
List of Text Books:			
1.	R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, John Wiley, 2001		
2.	S. Theodoridis and K. Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009		
3.	C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006		
List of Reference Books:			
1.	Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Publications.		
2.	S. M. Ross, Introduction to Probability models, Academic Press, 2010. (for probability).		
3.	S. Theodoridis et al, 'Introduction to Pattern Recognition, A MATLAB Approach'. Academic Press, 2010.		
4.	A. K. Jain et al., Statistical Pattern Recognition: A Review, January 2000.		
URLs:			
1.	https://www.youtube.com/watch?v=KNAWp2S3w94		
2.	https://www.youtube.com/watch?v=y9lueF5-nEg		
3.	https://www.youtube.com/watch?v=aircAruvnKk&t=526s		

Lecture Plan (about 40-50 Lectures):	
Lecture No.	**Topic**
1.	Introduction to AI and ML
2.	Introduction to Neural Network, Deep Learning, and Generative Networks.
3.	Types of learning, ML design cycle,
4.	Statistical pattern recognition,
5.	Standard PDFs and PMFs (Uniform, Normal, Exponential, Bernoulli, Binomial distributions)
6.	Normal and multivariate normal distributions
7.	Data acquisition and pre-processing methods
8.	Supervised Learning Model: KNN-Inclusion of prior knowledge, data normalization, weighted KNN
9.	Supervised Learning Model: Linear SVM
10	SVM- Soft margin approach and kernel trick
11	Decision Tree
12	Bootstrap and Random Forest
13	ANN: Biological inspiration and Perceptron
14	MLP
15	Backpropagation
16	Bayes Theorem and Bayesian decision theory
17	Bayes Classifier
18	Discriminant function and decision surfaces.
19	Introduction to parameter-estimation method and its need.
20	Maximum Likelihood estimation
21	Gaussian mixture models,
22	Expectation maximization method
23	Bayesian estimation
24	Naïve Bayes classification model
25	Scattering matrix and principal components
26	PCA for dimension reduction
27	LDA for dimension reduction
28	Linear discriminant function-based classifiers (SWLDA and BLDA)
29	Examples and classification methods of sequential data
30	Markov chains
31	Hidden Markov Models for sequential data classification
32	Recurrent NNs for sequential data classification
33	Regression analysis: Linear regression
34	Polynomial regression, interpolation and extrapolation
35	Clustering analysis
36	Types of clustering
37	Prototype based clustering
38	K-means clustering method

39	Hierarchical and other clustering methods,
40	Cluster validation