Indian Institute of Information Technology, Allahabad

Department of Electronics and Communication Engineering

UG curriculum proposal (with effect from July 2018)

Total Credit: 160

Semester 1 (BEC - 1)				Total Credit : 20		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Physics		Core (H)	4	2–1–1	Nil
2	Linear Algebra		Core (H)	4	3–1–0	Nil
3	Introduction to Programming in C		Core (H)	4	2–1–1	Nil
4	Fundamentals of Electrical & Electronics Engg.		Core (H)	4	2–1–1	Nil
5	Professional Communication		Core (H)	2	1--0--1	Nil
6	Principles of Management		Core (H)	2	1–1–0	Nil
					11–10–8	
		Total		20	29	

Semester 2 (BEC - 2)				Total Credit : 22		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre- Requisite
1	Univariate and Multivariate Calculus		Core (H)	4	3–1–0	Nil
2	Digital System Design		Core (H)	4	2–1–1	Nil
3	Data Structures		Core (H)	4	2–1–1	Introduction to Programming in C
4	Electronic Devices and Circuits		Core (H)	4	2–1–1	Nil
5	Electromagnetic Field and Waves		Core (H)	4	3–1–0	Nil
6	Electronic Workshop		Core (H)	2	0–0–2	Nil
					12–10–10	
			Total	22	32	

Semester 3 (BEC - 3)				Total Credit : 22		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre- Requisite
1	Analog Communication		Core (H)	4	2–1–1	Nil
2	Analog Electronics		Core (H)	4	2–1–1	Electronic Devices and Circuits
3	Electrical Engineering		Core (H)	3	2–0–1	Nil
4	Electronics Measurement and Instrumentation		Core (H)	3	2–0–1	Nil
5	Micro Processor Interface and Programming		Core (H)	4	2–1–1	Nil
6	Probability and Statistics		Core (H)	4	3–1–0	Nil
					13–8–10	
			Total	22	31	

Semester 4 (BEC - 4)				Total Credit : 20		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre- Requisite
1	Discrete Time Signals and Systems		Core (H)	3	2–1–0	Nil
2	Control Systems		Core (H)	4	2–1–1	Nil
3	Digital IC Design		Core (H)	3	2–0–1	Nil
4	Integrated Circuit Technology		Core (H)	3	2–1–0	Nil

5	Antenna and Wave Propagation		Core (H)	4	2–1–1	Electromagnetic Field and Waves
6	Operating Systems		Core (H)	3	2–0–1	Nil
					12–8–8	
		Total		20	28	

Semester 5(BEC - 5)				Total Credit : 20		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Digital Communication		Core (H)	4	2–1–1	Nil
2	Computer Networks		Core (H)	4	2–1–1	Nil
3	Embedded System Design		Core (H)	4	3–0–1	Nil
4	Microwave Engineering		Core (H)	4	2–1–1	Nil
5	SMT Workshop		Core (H)	1	0–0–1	Nil
6	Power Electronics		Core (H)	3	2–1–0	Nil
					11–8–10	
		Total		20	29	

Semester 6(BEC - 6)				Total Credit : 22		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Digital Signal Processing		Core (H)	4	2–1–1	Discrete Time Signals and Systems
2	Optical Communication		Core (H)	3	2–0–1	Nil
3	Principles of Wireless Communication		Core (H)	4	2–1–1	Nil
4	Elective 1		Core (S)	4	3–1–0	Nil
5	Elective 2		Core (S)	4	2–1–1	Nil
6	Mini Project		Core (S)	3	0–1–2	Nil
					11–10–12	
		Total		22	33	

Semester 7(BEC - 7)				Total Credit : 16		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Minor Project		Core (S)	10	0–1–9	Nil
2	Elective 3		Core (S)	4	2–1–1	Nil
3	Elective 4		Core (S)	4	2–1–1	Nil
					4–6–22	
		Total		18	32	

Semester 8(BEC - 8)				Total Credit : 18		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Major Project		Core (H)	12	0–2–10	Nil
2	Elective 5		Core (S)	4	3–1–0	Nil
					3–6–20	
		Total		16	29	

Note:

- A candidate can earn a maximum of 24 credits in any semester through regular registration including a dropped course.
- For dropped-out courses- Provision of Summer semester is introduced.
- A student has to take a minimum of 10 credit electives offered from ECE deptt for BTech in ECE stream.
- For the purpose of branch change, plz refer to Ordinance.
- A student can avail Add On's as per the list of even and odd semester baskets (provided it is offered by the respective department).

I Semester	II Semester	III Semester	IV Semester	V Semester	VI Semester	VII Semester	VIII Semester
+ 4 credits may be earned	+ 2 credits may be earned	+ 2 credits may be earned	+ 4 credits may be earned	+ 4 credits may be earned	+ 2 credits may be earned	+ 6 credits may be earned	+ 8 credits may be earned

Odd/Even Semester Basket [Subjects to be offered by Managamentdeptt, Applied Science and IT Deptt] [Subjects to be offered at the discretion of the deptt]	**Even Semester Basket Name** [Subjects to be offered by ECEDeptt – [Subjects to be offered at the discretion of the deptt]
Athletics, Yoga, community services, Society Services, Sports, Indian languages, Library management, Foreign Languages, Programming Languages (Python, C++) etc	Matlab programming, Microcontroller Programming, Emerging automotive technologies, Network Analysis, Electronic Testing equipments, Raspberry - Pi,Robotics , RF Planning and RF Engineering , Wavelets, Material Science, Electrical Power Systems, Nano Technologies, SDR, optical N/wetc

Syllabus

I Semester

Indian Institute of Information Technology, Allahabad
Department of Electronics & Communication Engineering

1. Name of the Course: **Physics**

2. LTP structure of the course: 2-1-1

3. Objective of the course: To let the first year B. Tech. (IT) students exposed to basic laws of nature and to demonstrate their application on physical systems and technical devices.

4. Outcome of the course: The students will learn how to handle dynamics of simple systems like point particle. They will also learn how to handle systems with constraints with the aid of powerful analytical treatment developed by Lagrange and Hamilton. Students will be exposed to laws of physics in the atomic or sub-atomic regime. Mathematical tools that the students will learn in this course will be highly beneficial for the students to explore many areas of Engineering stream including: Quantum computation, Robotics, Electronics etc.

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	1	Classical Mechanics: Revisiting Newton's laws of motion; Conservation Laws; Dlemberts Principle; Lagranges Equations; Calculus of Variations;	
	2	Hamiltons Principle; Hamil-ton's equations, Poisson brackets, Simple problems.. Basic ideas of Quantum Mechanics: Matter Waves; Wave and Group Velocities,	
Component 2	3	Heisenberg Uncertainty Principle, Wave Function, its Inter-pretation and Normalization; Superposition of Amplitudes, Dynamical Variables as Operators; Expectation Values;	
	4	Schrodinger Equation and its Simple Applications like Particle in a Box, Quantum Well, Potential Barrier Problem, Stern-Gerlach Experiment, Kets Bras and operators, Change of Basis, Harmonic Oscillator, Electron in periodic potential and band structure of solids	

6. Text Book:

Classical Mechanics:

Introduction to Mechanics; Kleppner and Kolenkow.

Classical Mechanics; H. Goldstein, C. Poole, J. Safko.

Quantum Mechanics:

Introduction to Quantum Mechanics by D . J. Griths Modern

Quantum Mechanics by J. J. Sakurai

Modern Physics by A. Beiser.

7. References:

L.D. Landau and E.M. Lifshitz, Mechanics. Theoretical Mechanics by M. Spiegel.
Feynman Lectures of Physics Vol-1 and Vol-3.

Quantum Physics for Atoms, Molecules, Solids, Nuclei and Particles by R Eisberg and R. Resnick.

1**. Name of the Course:** Linear Algebra

2. **LTP structure of the course:** 3-1-0

3. **Objective of the course:** Solving systems of linear equations, Understanding vector spaces, linear transformations, eigenvalue, eigenvector, generalized notion of angle, distance, and length, diagonalization and orthogonalization.

4.**Outcome of the course:** To able to solve systems of linear equations, work within vector spaces, to manipulate matrices and to do matrix algebra.

5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	System of linear equation, Gauss elimination method, Elementary matrices, Invertible matrices, Gauss-Jordon method for finding inverse of a matrix, Determinant, Cramer's rule, Vector spaces, Linearly independence and independence, Basis, Dimension
	Unit 2	Linear transformation, Representation of linear maps by matrices, Rank-Nullity theorem, Rank of a matrix, Row and column spaces, Solution space of a system of homogeneous and non-homogeneous equations, Inner product space, Cauchy-Schwartz inequality, Orthogonal basis,
Component 2	Unit 3	Grahm-Schmidt orthogonalization process, Orthogonal projection, Eigen value, eigenvector, Cayley-Hamilton theorem, Diagonalizability and minimal polynomial, Spectral theorem,
	Unit 4	Positive, negative and semi definite matrices. Decomposition of the matrix in terms of projections, Strategy for choosing the basis for the four fundamental subspaces, Least square solutions and fittings, Singular values, Primary decomposition theorem, Jordan canonical form

6. **Text Book:** Gilbert Strang, Linear Algebra, Cambridge Press.

7. **References Books:**

1. K. Hoffman and R. Kunze, Linear Algebra, Pearson.

2. S. Kumaresan, Linear algebra - A Geometric approach, Prentice Hall of India.

3. S. Lang, Introduction to Linear Algebra, Springer

1. Name of the Course: Introduction to Programming

2. LTP structure of the course: 2 1:1

3. Objective of the course: The purpose of this course is to provide the basic knowledge of C programming

4. Outcome of the course: The students will be able to program in C language with basic programming abilities

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction, pseudocode, data types, single precision floating point, representation, operators, bitwise operators, expressions and statements, operator precedence vs. order of evaluation, type casting, integral promotions, conversions (standard type and arithmetic), if-else condition, for loop, while loop, do-while loop, Jump statements.	
	Unit 2	1-d arrays, Strings, 2-d arrays, structure and union, pointers, functions, header files (math.h, time.h, custom headers), external functions.	
Component 2	Unit 3	Pointers, arrays vs. pointers, Pointers to pointers and pointers to functions, Pre-processor directives and macros, I/O handling.	
	Unit 4	Dynamic memory allocation, Linked lists, Command line arguments, Standard libraries	

6. Text Book:

a. Programming in ANSI C, 7th Edition by E. Balagurusami, TMH

b. Let Us C, 15th Edition by YashwantKanetkar, BPB Publication

7. References: a. The C Programming Language, 2nd Edition By Brian W. Kernighan, Dennis M. Ritchie, PHI

1. Name of the Course: Fundamentals of Electrical and Electronics Engineering

2. LTP structure of the course: 2:1:1

3. Objective of the course: This course is intended to be the text for a first course in electronics engineering. It is partitioned into four parts circuits, electronics, digital systems, and electro-mechanics. Although many topics are covered in each of these parts, the syllabus is more than just a survey of the basics of electrical engineering.

4. Outcome of the course :To provide an overall picture and working principles of electronics and electrical devices.The students will understand the working principles of network theorems, AC circuits, Transformers, Electrical Motors and simple semiconductor diode circuits.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Network Theorems**: Network graphs and matrices, Transient and Steady-State Analysis, theorem.	
	Unit 2	**DC and AC circuits**, Transformer, Transformers, Rotating coil devices	
Component 2	Unit 3	**Semiconductor Diodes**: Semiconductors, Junction diode Zener diodes, Simple circuits	
	Unit 4	**Introduction to Logic Circuits:** Boolean Algebra, Simple gates, Boolean Theorems.	

6. Text Book:

1. Fundamentals of Electrical Engineering, Leonard S Bobrow, 2nd Edition, Oxford Press.

2. Fundamentals of Electrical Engineering and Electronics, B L Thereja, S Chand Press.

7. References:

1. Network Analysis, M E van Valkenberg, 3rd Edition, PHI, 2000

2. Linear Circuit Analysis: Time, Domain, Phasor and Laplace Transform Approaches, R A DeCarlo and
3. -M Lin, 2nd Edition, Oxford University Press, 2000

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1. Name of the Course: PROFESSIONAL COMMUNICATION

2. LTP structure of the course: 1-0-1

3. Objective of the course: The focus of the course is to engage and involve students with hands on situation and solve problems on regular basis.

4. Outcome of the course: The course is designed to enhance and polish communication skills of undergraduate students which will formally help them to be effective professionals by understanding importance of effective communication, presentation and designing of work.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage
Component 1	Unit 1 & Unit 2	Introduction to Types of communication , Speech and diction correction and counseling Formal communication I. Cover letter II. CV preparation III. Group discussion IV. Personal interview V. Report writing VI. Proposal development (Product development plan)
Component 2	Unit 3	Interview types and techniques
		I. Role play II. Moderation and intervention techniques III. SWOT Analysis

6. Lab Exercises to be done in LAB Session.

7. References: Winning at Interviews by Edgar Thorpe

1. Name of the Course: **Principles of Management**

2. LTP structure of the course: 1-1-0

3. **Objective of the course:**

This course is designed to be an overview of the major functions of management. It explores how organizations develop and maintain competitive advantage within a changing business environment. Upon completion, students should be able to work as contributing members of a team utilizing these functions of management.

4. **Outcome of the course:**

Explain how organizations adapt to an uncertain environment and identify techniques managers use to influence and control the internal environment. Practice the process of management's four functions: planning, organizing, leading, and controlling.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage
Component 1	Unit 1	Nature and Functions of Management - Importance and Process of Management - Development of Management Thoughts - Managerial Roles
	Unit 2	International Business and its Environment- globalization &WTO-. Dynamics of development Global business environment-. Internal and External analysis. Nature and Importance of Planning Management by Objectives Decision Making MIS Forecasting: Techniques of Forecasting.
Component 2	Unit 3	Need for Organization - Principles and Process of Organizing – Span of Management Organization Structure Departmentalization Authority, Delegation and Decentralization
	Unit 4	Staffing and Directing Requirement of Effective Direction Supervisor and his Qualities Co-Ordination Control

6. Text Book: Mandatory for UG core courses

1. Koontz, Weihrich, Aryasri. Principles of Management, TATA McGraw Hill, New Delhi, 2004.

7. References:

1. P.C.Tripathi, P.N. Reddy, Principles of Management, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Prasad LM, Principles and Practice of Management, Sultan Chand & Sons, New Delhi.
3. Samuel C. Certo, S. TrevisCerto, Modern management 10 Ed, PHI Learning, New Delhi, 2008
4. James A. Stoner, Edward Freeman, Daniel Gilbert, Management, PHI Learning, New Delhi, 2007
5. Williams/ Kulshrestha, Principles of Management, Cengage Learning, New Delhi, 2011

II SEMESTER

1**. Name of the Course:** Univariate and Multivariable Calculus

2. **LTP structure of the course:** 3-1-0

3. **Objective of the course:** Develop a solid understanding of infinite sequences and series, understand the concept of limit, continuity and differentiability of functions of single and multivariable, understand partial derivatives, directional derivatives of several variable function, rectangular, cylindrical and spherical coordinates systems, Multiple integrals, vector fields.

4. **Outcome of the course:** To Compute limits and derivatives of functions, Apply the Fundamental Theorem of Calculus, Distinguish between the concepts of sequence and series, and determine limits of sequences and convergence and approximate sums of series, and define, differentiate, and integrate functions represented using power series expansions, including Taylor series, Compute limits and derivatives of functions of two and three variables, solve constraint problems using Lagrange multipliers, Evaluate double and triple integrals for area and volume.

5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	The Real Number System, Convergence of a Sequence, Monotone Sequences, Cauchy Criterion, Bolzano-Weierstrass Theorem, Continuity and Limits, Existence of Maxima, Intermediate Value Property, Differentiabilty, Mean Value Theorem, Sufficient Conditions for Local Maximum, Point of Inflection
	Unit 2	Taylor's Theorem, Infinite Series, Convergence Tests, Leibniz's Theorem, Power Series, Taylor Series, Riemann Integration, Fundamental Theorems of Calculus, Riemann Sum, Improper Integrals, Area Between Two Curves, Polar Coordinates, Volume of Solids, Length of a plane curve, Areas of Surfaces of Revolution, Calculus of Vector Valued Functions
Component 2	Unit 3	Functions of Several Variables, Directional Derivatives, Gradient, MVT, Maxima, Minima, Second Derivative Test, Lagrange Multiplier Method,
	Unit 4	Multiple integrals, Line and Surface integrals, Green's Theorem , Stokes' Theorem, The Divergence Theorem

6. **Text Book:** G. B. Thomas, M. D. Weir. J. Hass, and F. Giordano, Thomas' Calculus, Pearson.

7. **References Books:**

1. T. M. Apostol, Calculus, Vol. 1, Wiley.

2. T. M. Apostol, Calculus, Vol. 2, Wiley.

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1. Name of the Course: Digital System Design
2. LTP structure of the course: 2:1:1
3. Objective of the course: This course is designed for the students seeking an extensive understanding of digital electronics and system design and problem solving techniques. It is partitioned into four parts
4. Outcome of the course: After completion of this course, the student will be independent to drill any real world problems in this subject and appear in any challenging competitive exams.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Pulse circuits:**Switching times &behavior of transistors – symmetrical/ asymmetrical triggering bi/monostable - astable.	
	Unit 2	**Combinational Logic Design:** Multiplexers and De-multiplexers, Binary Adders, Subtraction and Multiplication.	
Component 2	Unit 3	**Sequential Network:** Concepts of Sequential Networks, Analysis, Counters and Shift Registers, state machine**.**	
	Unit 4	**Memory Elements and Arrays** Registers, RAM and ROMs, programmable logic array, Memories. Data Converters	

6. Text Book:

M. Morris Mano, Digital Design, 2000.
M. Morris Mano, Digital Logic and Computer Design, 2004.
N. Balabanian, and B. Carlson, Digital Logic Design Principles, JohnWiley& Sons, 1998.
A.P.Malvino, and D.P.Leach, Digital Principles and Applications, 6th Ed., Tata McGraw Hill, 2008.
T.L.Floyd, Digital Fundamentals, 8th Ed., Pearson Education, 2000.

7. **References Books:**
J.F. WakerlyDigital design, Pearson Edu., 2000.

1. **Name of the Course**: Data Structures

2**. LTP structure of the course**: 2-1-1

3. Objective of the course: To teach the linear and non-linear structures in which data can be stored and their pros and cons. To appreciate the need and working of different ways of storing data. To write algorithms that make use of different data structures.

4. Outcome of the course: The students will learn different structures by which data can be stored, retrieved and modified. This forms the foundations for the course on algorithms and a sound knowledge is used in almost every course and project work prescribed by the institute. The course emphasizes on lab work wherein the students learn not only to make different data structures, but also their application in different synthetic problems.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Stacks, Queues, Linked List	
	Unit 2	Recursion, Searching and Sorting	
Component 2	Unit 3	Trees, Priority Queue	
	Unit 4	Hashing, Graphs	

6. Text Books/Reference:-:

1. T. H. Cormen, C.E. Leiserson, R.L. Rivest, C. Stein,Introduction to Algorithms 3rd ed., PHI, New Delhi, 2009.

2.Y. Langsam, M. J. Augenstein, A. M. Tenenbaum, Data Structures Using C and C++, PHI, New Delhi, 2001.

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1. Name of the Course: Electronic Devices and Circuits
2. LTP structure of the course: 2:1:1
3. Objective of the course: This course is designed for the students seeking an extensive understanding of electronic devices and circuits and problem solving techniques. Being a freshman and a core course in electronics engineering, the lucidity is maintained throughout. It is partitioned into four parts semiconductor diodes, bipolar junction transistors, MOSFET and their small signal analysis.
4. Outcome of the course: After completion of this course, the student will be independent to drill any real world problems in this subject and appear in any challenging competitive exams.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Semiconductor Diodes& Circuits:** Physical operation of p-n junction diodes, Light emitting diodes, photo diode, circuits	
	Unit 2	**Small Signal and Large Signal Analysis of BJTs:** Small & Large Signal Analysis of CE,CB,CC Multistage Amp.	
Component 2	Unit 3	**MOSFETs:** Energy band diagrams, Flat-band pinch-off voltage, JFET, Complementary MOS (CMOS), V-I Characteristics.	
	Unit 4	**Small Signal &Large Signal Analysis of FETs:** Small Signal & Large Signal Analysis of CS, CD, Multistage.	

6. Text Book:
A. S. Sedra, K. Carless Smith Microelectronics, , 7thEdition, Oxford University.
Integrated Electronics, J Milllman and C Halkias, TMH Press.

1. Name of the Course: Electromagnetic Field and Waves
2. LTP structure of the course: 3-1-0
3. Objective of the course: To let the Second Semester B. Tech. (ECE) students exposed to basic laws of Electromagnetism and to demonstrate their application on RF Communication.
4. Outcome of the course: The students will learn how to handle the RF Communication
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction to Vector Analysis, Electrostatics and Magnetostatics	
	Unit 2	Time-Varying Fields and Maxwell's Equations	
Component 2	Unit 3	Uniform Plane Waves	
	Unit 4	Transmission Lines and Smith Chart	

6. Text Book:
D.K. Cheng,Field and Wave Electromagnetic, 2nd Ed., Welsley Publishing Company, 1989.

7. References:
J. A. Edminister, Electromagnetics, Schaum's Outline Series, 1998.

W H Hayt and J A Buck, Engineering Electromagnetics, Oxford University Press, 2000

1. Name of the Course: Electronic Workshop
2. LTP structure of the course: 0:0:2
3. Objective of the course: To let the students exposed to basic of **Electronic Workshop**
4. Outcome of the course: The students will learn PCB design and other aspects of electronic workshop
5. **Course Plan: Will be announced in the lab.**

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III SEMESTER

1. Name of the Course: Analog Communication
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the students exposed to basic of communication Engineering
4. Outcome of the course: The students will learn analog communication and design aspects of Communication
5. **Course Plan:**

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Continuous Time Signals and Systems	
	Unit 2	Analog Baseband and Bandpass Transmissions	
Component 2	Unit 3	Analog to digital conversion	
	Unit 4	Noise and its implications on the analog Communication systems	

6. Text Book/ References:
A B Carlson, Communication, Pearson, 2000
B P Lathi and Z. Ding, Modern Analog and Digital Communication Systems, Oxford Press, 2002.

1. Name of the Course: Analog Electronics
2. LTP structure of the course: 2-1-1
3. Objective of the course: The goal of this syllabus, as its name implies, is to allow the reader to become proficient in the analysis and design of circuits utilizing modern linear ICs.
4. Outcome of the course: After completion of this course, the student will be independent to drill any real world problems in this subject and appear in any challenging competitive exams.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	General feedback structure, Types, Properties of negative feedback, Barkhausen criterion, Oscillators.	
	Unit 2	Differential Amplifier, passive and active current mirror circuits, Ideal Op-Amp, Characteristics and application	
Component 2	Unit 3	Op-amp as Instrumentation amplifier, Summing amplifier, Integrator, Differentiator, filters.	
	Unit 4	555 Timer IC and applications, PLL.	

6. Text Book:
J Millman and C Halkies, Integrated Electronics by, TMH Press, 1995.
J Millman and AGrabel, 2nd Edition, Microelectronics, 1998.
R Gregorian, Introduction to CMOS Op-Amp and Comparators",John Wiley & Sons. 1999
P R Gray, P T Hurst, S H Lewis and R G Meyer, "Analysis and Design of Analog Integrated Circuits", 4th Ed., John Wiley & Sons. 2001
R Gayakwad, "Op-amp and Linear Integrated Circuits", 4th Ed.,Pearson Education.2005
R F Coughline, and F F Driscoll, "Operational Amplifier and Linear Integrated Circuits", 6th Ed., Prentice-Hall of India.2002
W D Stanley, "Operational Amplifier with Linear Integrated Circuits", 3rd Ed., Merril.1993

7. References:
J M Fiore,Operational Amplifiers & Linear Integrated Circuits: Theory and Application Theory and Applications, Cambridge U Press, 2003
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Name of the Course: Electrical Engineering
2. LTP structure of the course: 2-0-1
3. Objective of the course: To expose them to basics of electrical engineering.
4. Outcome of the course: Students will be able to understand basic of electrical system. How they can and analyse, design and build any electrical system. They will be able to understand the basic function of basic electrical machines and equipment.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction to power systems, Transformer analysis, Concept of AC and DC transmission	
	Unit 2	**3-phase systems:** Three phase voltages and currents, Delta connection, Three phase, Power measurement methods.	
Component 2	Unit 3	**Magnetic Circuits:** Electricity and Magnetism and force, flux density, field intensity, Electromechanical Energy Conversion	
	Unit 4	**Introduction to Electric Machines:** DC& AC Machines, DC Generators, DC Motors, Alternator, Power Amplifiers	

6. Text Book:
A. E. FitzgeraidCKingsley and AKusko, Electric Machinery,6th Ed., McGraw-Hill International Book Company.2008
G.K. Dubey, Fundamentals of Electrical Drives, Cambridge U Press, 2000
M. G.Say and E. O.Taylor, Direct Current Machines, 3rd Ed.,ELBS and Pitman.1986
I. J.Nagrath and D. P. Kothari, Electrical Machines, 3rd Ed., TataMcGraw-Hill Publishing Company Limited.2008.

Name of the Course: Electronics Measurement and Instrumentation
2. LTP structure of the course: 2-0-1
3. Objective of the course: To introduce them to the basics of measuring instruments. To make them aware of working and practical application of instruments. They will be exposed to sensors.
4. Outcome of the course: They will be able to understand the working principle of various instruments. That will help to make better use of measuring instruments. They will be able to use different kind of sensor. How to select a suitable measuring instrument for the any measurement. They want to build sensor for measurement they will be able to select proper material according to the need or system.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Theory Of Errors**:Accuracy& precision, Systematic & random errors Modeling of errors, Combination of errors.	
	Unit 2	**Electronic Instruments For Measuring Basic Parameters**: Electronic Voltmeters, Shielding & grounding, CTPT.	
		Oscilloscopes: Basic construction, working and use of it. Kinds of Oscilloscope.	
Component 2	Unit 3	**Signal Generation and measurement techniques**: Sine wave generators, Harmonic distortion analyzer, Spectrum analyzer.	
	Unit 4	**Transducers**Classification,Selection Criteria, Characteristics, Construction, Application of following of different transducers.	

6. Text Book:
A.K. Sawhney, PuneetSawhney,A Course In Electrical And Electronic Measurements And Instrumentation, DhanpatRai Publications, 2012
H. S. Kalsi, Electronic Instrumentation,3 edition, McGraw Hill Education, 2017

1. Name of the Course: Microprocessor Interface and Programming
2. LTP structure of the course: 2-1-1
3. Objective of the course: To demonstrate an understanding of the fundamental properties of Microprocessor Interface and Programming.
4. Outcome of the course: The student will learn the basics and working of Microprocessor, its Interface and Programming
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Introduction:**fixed and floating point arithmetic, Architecture comparison, Performance enhancement techniques,	
	Unit 2	Memory organization**,** Pipelining**,** 8086 Architecture, Instruction Sets Minimum and Maximum mode configurations, Interrupts	
Component 2	Unit 3	**Peripherals and Interfacing:** peripherals,Programmable communication interface. DMA	
	Unit 4	**Ad Microprocessors and Microcontrollers:** Basics of Ad processors, Multiprocessors	

6. Text Book:
J L Hennessy, D A. Patterson, Computer Organization
D.V. Hall, Microprocessors and Interfacing, 3rd Edition (English) 3rd Edition, 2000.

1**. Name of the Course:** Probability & Statistics

2. **LTP structure of the course:** 3-1-0

3. **Objective of the course:** This course provides an elementary introduction to probability and statistics with applications. The topics covered in this course are basic concept of probability and statistics, random variables, probability distributions, Bayesian inference, joint probability distributions, random vectors, central limit theorem, confidence intervals.

4. **Outcome of the course:** The topics covered in this course would be very much useful for the B. Tech. to develop basic understanding of the subject. This course would also provide the students the background required to apply the basic concepts of probability and statistics in handling large data, analysing noise in a system and studying stochastic processes.

5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	Probability: Axiomatic definition, Properties, Conditional probability, Bayes rule and independence of events, Random Variables, Distribution function.
	Unit 2	Linear transformation, Representation of linear maps by matrices, Rank-Nullity theorem, Rank of a matrix, Row and column spaces, Solution space of a system of homogeneous and non-homogeDiscrete and Continuous random variables, Expectation, Function of random variable, Moments, Moment generating function, Chebyshev's and Morkov's inequality. Bernoulli, Binomial, Geometric, Negative binomial, Hypergeometric, Poisson, Discrete uniform, Continuous uniform, Exponential, Gamma, Normal.
Component 2	Unit 3	Random vector: Joint distributions, Marginal and conditional distributions, Moments, Independence of random variables, Covariance, Correlation, Functions of random variables.
	Unit 4	Law of Large Numbers: Weak law of large numbers, Levy's Central limit theorem (independently and identically distributed with finite variance case), Normal and Poisson approximations to Binomial, Statistics: Introduction: Population, Sample, Parameters, Point Estimation: Method of moments, Maximum likelihood estimation, Unbiasedness, Consistency, Interval Estimation: Confidence interval.

6. **Text Book:**

1. Sheldon M. Ross, An Introduction to Probability Models, 10th Edition, Academic Press, Elsevier.

2. Sheldon M. Ross, An Introduction to Probability and Statistics for Engineers and Scientists, 3rd Edition, Academic Press, Elsevier.

7. **References Books:**

1. Rohatgi, V. K. and Saleh, A. K. (2000), *An Introduction to Probability and Statistics*, 2nd Edition, Wiley-interscience.

2. Bertsekas, D. P. and Tsitsiklis, J. N. (2008), *Introduction to Probability*, Athena Scientific, Massachusetts.

3. Montgomery, D. C., Peck, E. A. and Vining, G. G. (2012), *An Introduction to Linear Regression Analysis*, 5th Edition, Wiley.

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IV SEMESTER

1. Name of the Course: Discrete Time Signals and Systems
2. LTP structure of the course: 2-1-0
3. Objective of the course: To demonstrate an understanding of the fundamental properties of linear time invariant systems.
4. Outcome of the course: The student will learnto analyze the spectral characteristics of continuous-time and discrete-time signals using Fourier analysis.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Continuous-Time signals; Analysis of Continuous-Time LTI Systems; Review of Fourier and Laplace transforms	
	Unit 2	Discrete-Time Signals; Sampling; Analysis of Discrete-Time LTI Systems	
Component 2	Unit 3	Discrete Time Fourier Series; Discrete Time Fourier Transform and properties	
	Unit 4	Z-Transform and Its Application to the Analysis of LTI Systems and properties	

6. Text Book:
A. V. Oppenheim and R. W. Schafer, Discrete-Time Signal Processing, 2nd ed. Pearson Education, 2003.
J.G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 3rded. Prentice-Hall, 1996.

7. References:
S. Haykin and B. V. Been, Signals and Systems 2nd Ed., John Wiley & Sons. 2003.
R.E. Ziemer, W.H. Tranter, and D.R. Fannin, Signals and Systems: Continuous and Discrete, 4th ed., Pearson Education, 2001.
B. P. Lathi, Linear Systems and Signals, 2nd ed., Oxford University Press, 2005.

11. Name of the Course: Control Systems
2. LTP structure of the course: 2-1-1
3. Objective of the course: To introduce them to the basic of control systems. How a basic control system is formed. How they can analyze and build a control system.
4. Outcome of the course: Students will be able to analyze a control system if given to them. They will be able to find the equivalent mathematical model for it and if the system is not stable they will be able to, by the use techniques learned in this course, stabilize the system.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Introduction to Control Systems:** Basic Concepts of Control Systems, Feedback characteristics of Control Systems	
	Unit 2	**Time response Analysis:** Standard Test Signals. Time response of different order of systems. concept of stability.	
Component 2	Unit 3	**Frequency Response Analysis:** Frequency domain specifications, Gain and Phase Margin.	
	Unit 4	**Stability in frequency domain:** Root locus concepts, Effect of adding open loop poles and zeros, Nichol's chart, controllers.	

6. Text Book:
N S. Nise, Control Systems Engineering, International Student Version, 6th Edition, Wiley, April 2011.

R H. Bishop, Richard C. Dorf, Modern Control Systems, 12th edition, PEARSON HIGHER EDUCATION, 2010.

I.J. Nagrath and M Gopal, Control Systems Engineering, 6th edition, New Age International Pvt Ltd, 2017

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1. Name of the Course: Digital IC Design
2. LTP structure of the course: 2–0–1
3. Objective of the course: To make students familiar with fundamentals of digital IC/system design using MOS/CMOS digital logics and circuits. Students also would be benefited by the Lab experiments
4. Outcome of the course: Students will be able to solve industry standard problems in digital system design.
5. Course Plan:

Component	Unit	Topics for Coverage	
Component 1	Unit 1	**Introduction:** VLSI Design Flow, Design Hierarchy, Scaling and Small-Geometry effects, MOS Inverters	
	Unit 2	**Static and Dynamic MOS circuits**: CMOS Inverters, Logic gate design, elmore delay	
Component 2	Unit 3	**Combinational and Sequential Circuits**, Switching Characteristics, Timing Circuits, Clocks, state machines	
	Unit 4	**Memory:**NAND-NORFlash Memory, SRAM DRAM.	

6. Text Book:
M.JanRabaey, A. P. Chandrakasan, and B.Nikolic.Digital integrated circuits.Vol. 2. Englewood Cliffs: Prentice hall, 2002.
Sung-MoKang, and Y Leblebici. CMOS digital integrated circuits.Tata McGraw-Hill Education, 2003.

7. References:
D.A. Pucknell, and K Eshraghian, Basic VLSI Design, 3rd Ed.,Prentice-Hall of India.
N H.E.Weste, D Harris, CMOS VLSI Design-A Circuits and Systems Perspective. 3rd Edition, Pearson Education, International Edition.

1. Name of the Course: Integrated Circuit Technology
2. LTP structure of the course:2-1-0
3. Objective of the course: The subject provides an in-depth knowledge of how a semiconductor device is prepared right from the substrate preparation to device fabrication.
4. Outcome of the course: The subject Integrated Circuit (IC) Technology deals with the basic principles underlying the fabrication process of semiconductor devices and integrated circuits.
5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.
Component 1	Unit 1	Crystal Growth and Wafer Preparation: crystal structures, Wafer Fabrication, Stacking fault	Chapter 1, S. M. Sze OR Chapter 1 and 3, S K Gandhi
	Unit 2	Thermal Oxidation and Nitridation of Silicon: Oxidation kinetics (general solution, growth and VPE	Chapter 2 & 3, S. M. Sze OR Chapter 7&5, S K Gandhi
Component 2	Unit 3	Lithography: Photolithography steps (Soft bake, Patterning), Photoresists, Wet Etching	Chapter 4&5, S. M. Sze OR Chapter 9 & 10, S K Gandhi
	Unit 4	Diffusion:Fick's law of diffusion and their solutions, Mechanism of diffusion, CVD, Problems in metallization.	Chapter 7, 8&9, S. M. Sze OR Chapter 4, 6 & 8, S K Gandhi

6. Text Book: Mandatory for UG core courses
S. K. Gandhi, VLSI Fabrication Principles: silicon and Gallium Arsenide, John Wiley & Sons, Second Edition

7. References:
S. M. Sze, VLSI Technology, McGraw Hill Education, Second Edition.
G. S. May and S M Sze, Fundamentals of Semiconductor Fabrication, John Wiley & Sons,
J. D. Plummer, M. D. and P. D. Griffin, Silicon VLSI Technology: Fundamentals, Practice, and Modeling, Pearson Education.
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1. Name of the Course: Antenna and Wave Propagation

2. LTP structure of the course: 2-1-1
3. Objective of the course: To explain the theory of different types of antennas used in communication systems, and different mechanisms of wave propagation in free space.
4. Outcome of the course:
By the end of the course, the students will be able to apply the concepts of antenna in its analysis, design, and measurements.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction, Antenna Parameters, Auxiliary Potential Functions	
	Unit 2	Linear Wire Antennas, Antenna arrays	
Component 2	Unit 3	Types of antennas: Travelling wave, Aperture, Reflector, Lens, Microstrip etc.	
	Unit 4	Wave Propagation with general application:	

6. Text Book:

C A Balanis, Antenna Theory and Design.3rd Ed., John Wiley & Sons. 2005
A. R. Harish, and M. Sachidananda. Antennas and wave propagation. Oxford University Press, USA, 2007.

7. References:
W. L. Stutzman, and H.A.Thiele, Antenna Theory and Design.2nd Ed., John Wiley & Sons. 1998

R. S. Elliot, ,Antenna Theory and Design. Revised edition, Wiley-IEEE Press. 2003

R. E. Collin, Antennas and Radio Wave Propagation. McGraw-Hill. 1985.

R. K. Shevgaonkar, Electromagnetic waves. Tata McGraw-Hill Education, 2005.

1. Name of the Course: Operating System
2. LTP structure of the course: 2-0-1
3. **Objective of the course:**

i. To understand the services provided by and the design of an operating system.

ii. To understand the structure and organization of the file system.

4. Outcome of the course:

I. Students should demonstrate the ability to design, implement and evaluate a computer based system, process, program to meet the desired needs
5. Course Plan:

Component	Unit	Topics for Coverage
Component 1	Unit 1	OS Basics : Definition, Operating Systems as resource manager, Evolution of OS, Structural overview, Types of OS; System Calls, Types of System Call, Hardware requirements: protection, context switching, privileged mode; Processes, Process Concept, Process Scheduling, Threads : Overview, Multithreading Models, Threads and their Management; CPU Scheduling : Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling
	Unit 2	Process Management : Operations on Processes, Interprocess Communication; Process Synchronization : The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Monitors, Semaphores, Classic Problems of Synchronization Deadlocks : System Model, Dynamic Resource Allocation, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery From Deadlock
Component 2	Unit 3	Memory Management: Main Memory Basics, Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation, Basics of Virtual Memory, Demand Paging, Page Replacement, Allocation of Frames, Thrashing Storage Management : Design of IO systems, File Management, Memory Management: paging, virtual memory management, Distributed and Multiprocessor Systems, Case Studies,
	Unit 4	Directory Structure, File-System Mounting, File Sharing, File-System Structure File-System Implementation, Directory Implementation, Allocation Methods, Mass-Storage Structure, Overview of Mass-Storage, Disk Scheduling, Disk Management Case Study – xv6 operating system

6. Text Book:

Abraham Silberschatz Peter B. Galvin and Greg Gagne, Operating System Concepts, Wiley 8th Edition, 2008.

7. References:

1. Garry. J. Nutt, Operating Systems: A Modern Perspective, Addison-Wesley
2. Andrew S. Tanenbaum and Herbert Bros, Modern Operating Systems (4th Edition), Pearson
3. William Stallings , Operating Systems: Internals and Design Principles, Prentice Hall of India
4. D. M. Dhamdhere , Operating Systems: A Concept-Based Approach, Tata McGraw-Hill
5. Russ Cox, FransKaashoek, Robert Morris , xv6: a simple, Unix-like teaching operating system

V SEMESTER

1. Name of the Course: Digital Communication

2. LTP structure of the course: 2-1-1

3. Objective of the course: To learn about the fundamental concepts of digital communications.

4. Outcome of the course: Student will learn to use the knowledge for designing various communication networks.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	**Unit 1**	Baseband digital signal transmission	
	Unit 2	Fundamentals of the Information Theory	
Component 2	**Unit 3**	Bandpass digital signal transmission	
	Unit 4	Principles of the error control coding	

6. Text Book/. References:

A B Carlson et. al., Communication Systems, 4^{th}/5^{th} edition McGraw Hill International

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1. Name of the Course: Computer Networks

2. LTP structure of the course: 2-1-1

1. Objective of the course: This course introduces the fundamental concepts of computer networks and different protocols used to connect and transfer data.
2. Outcome of the course: After completing the course, students can realize the network communication, practical experience of networking and usage of specific protocols in various requirements.
3. Course Plan: As per the below format only

Component	Unit	Topics for Coverage
Component 1	Unit 1	Introduction to Computer Networks, OSI & TCP/IP Reference Models, Physical Layer.
	Unit 2	Data Link Layer Framing, Error Control, Error Detection and Correction, Flow Control. Data Link Protocols: Simplex Stop-and-Wait Protocol, Sliding Window Protocols, One-Bit Sliding Window Protocol, Go-Back-N and Selective Repeat, HDLC, PPP Medium Access Control Sublayer, The Channel Allocation. Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access Protocols, IEEE 802.x Ethernet, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet, Wireless LANs - IEEE 802.xx , Bluetooth, RFID, Bridges, Virtual LANs
Component 2	Unit 3	Network Layer: Design Issues, Store-and-Forward Packet Switching, Virtual-Circuit and Datagram Networks, Routing: Shortest Path Algorithms, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Anycast Routing, Routing for Mobile Hosts, Routing in Ad Hoc Networks, Congestion Control: Approaches, Traffic-Aware Routing, admission Control, Traffic Throttling, load Shedding. Quality Of Service: Application Requirements, Traffic Shaping, Packet Scheduling, Admission Control, Integrated Services, Differentiated Services, The IPv4 and v6, IP Addressing, Internet Control Protocols, Label Switching and MPLS, OSPF, BGP, Internet Multicasting, Mobile IP.
	Unit 4	Transport Layer: Connection Establishment, Connection Release, Flow Control and Buffering, Multiplexing, Congestion Control Algorithms UDP, Remote Procedure Call, TCP, Delay Tolerant Networks. Application Layer Protocols.

4. Text Book
   - Computer Networks, A System Approach, by Larry L. Peterson , Bruce S .Davie ,5th Edition, 2011

5. Reference Books
   - Computer Networks, Andrew S. Tanenbaum, 5th Edition, 2010
   - Routing in Internet, Christian Huitema, 2nd Edition, 1999
   - Internetworking with TCP/IP, Vol. I, Vol. II and Vol. III, by Douglas E. Comer , David L . Stevens , 3rd Edition, 2000
   - Computer Networking: A Top-Down Approach Featuring the Internet , James F. Kuross, Keith W. Ross., 6th Edition
   - Data Communications and Networking, Behrouz A. Forouzan, 5th Edition, McGraw-Hill.

1. Name of the Course: Embedded System Design
2. LTP structure of the course: 3-0-1
3. Objective of the course: To enable the student to fundamental properties of Embedded System Design and Programming.
4. Outcome of the course: By the end of the course, the student will be able to learn embedded system design and programming.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Introduction:** Design Process of embedded system; Hardware/Software Interface; Pipelining	
	Unit 2	**Implementation of Embedded Systems:** Hardware implementation methodologies; Execution and Interaction	
Component 2	Unit 3	**Embedded Processor:** Performance and efficiency of ARM architecture; Data processing, parallelism.	
	Unit 4	**Interfacing:** Memory Interfacing, I/O interfacing, Real Time OS, Scheduling, Memory and I/O, Testing.	

6. Text Book/References:

S. Heath, Embedded systems design. Newnes, 2002.
J L Hennessy, D A. Patterson, Computer architecture: a quantitative approach. Elsevier, 2012.
W Wolf, FPGA-based system design. Pearson Education, 2004.

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1. Name of the Course: Microwave Engineering

2. LTP structure of the course: 2-1-1
3. Objective of the course: To provide a comprehensive introduction to various devices and passive components used at microwave frequencies.
4. Outcome of the course: By the end of the course, the student will be able to learn microwave engg, design aspects and its applications.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction to Microwaves: Microwave Frequency bands and applications, Waveguides/Cavity Resonators.	
	Unit 2	Passive microwave devices. S parameter analysis of all components.	
Component 2	Unit 3	Microwave Tubes. Solid state Amplifiers and Oscillators.	
	Unit 4	Strip Lines: Microstrip Lines, Parallel Strip Lines, Microstrip Component.	

6. Text Book:

D.M. Pozar, Microwave Engineering.3rd Ed., John Wiley & Sons. 2004.
S.Y. Liao, Microwave Devices and Circuits.Prentice-Hall of India. 1991.

7. References:
R.E. Collin, Foundations for Microwave Engineering. 2nd Ed., John Wiley & Sons. 2000.
B G Streetman, and S K Banerjee, Solid-state Electronic Devices.6th Ed., Prentice-Hall of India. 2006.
S. M. Sze, and K.K. Ng, ,Physics of Semiconductor Devices. 3rd Ed., John Wiley & Sons. 2006.
I Bahl and P Bhartia, Microwave Solid State Circuit Design.2nd Ed., John Wiley & Sons. 2003.

1. Name of the Course: SMT Workshop
2. LTP structure of the course: 0:0:1
3. Objective of the course: To let the students exposed to basic of Surface mount Technology
4. Outcome of the course: The students will learn SMT Fabrication and other aspects of SMT & PCB design.
5. **Course Plan: Will be announced in the lab.**

1. Name of the Course: Power Electronics
2. LTP structure of the course: 2–1–0
3. Objective of the course: To make students familiar with fundamentals of Power Electronic Devices and circuits, Design of ac-dc, dc-ac and dc chopper circuits of single phase and three phase applications
4. Outcome of the course: Students will be able to solve industry standard problems in power electronics.
5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Power devices: Power diodes, SCR: Device structure, Static characteristic, dynamic Power MOSFET, IGBT.	
	Unit 2	Rectifiers: Diode rectifiers Applications: Power Supplies, chemical process, DC link capacitive filter, issue of harmonics.	
Component 2	Unit 3	Dc-Dc Converters: DC- DC Power Converters, Limitations of Linear Power suppliesSMPS,	
	Unit 4	Inverters: Principle of operation of Inverters, Half bridge, full bridge, three phase- six step operation,voltage control, PWM.	

6. Text Book:
M. H.Rashid Power Electronics Circuits Devices and Applications. 3rd Ed., Pearson Education.
P. S. Bimbhra. Power Electronics.Khanna Publishers, 2002

References:
NMohan, T. M. Undeland and W P Robbins, “Power Electronics- Converters, Applications and Design”, 3rd Ed., Wiley India.

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VI SEMESTER

1. Name of the Course: Digital Signal Processing

2. LTP structure of the course: 2-1-1

3. Objective of the course: To learn about the advanced topics in the field of Digital Signal Processing.

4. Outcome of the course: Student will learn to utilize the advanced approaches of processing the signals and various aspects of discrete system design.

5. Course Plan: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	Review of the fundamental concepts of digital signal processing, DFT and FFT	
	Unit 2	Structures for realization of FIR and IIR systems and their analysis.	
Component 2	Unit 3	Design of FIR filters, Introduction of Multirate Signal processing	
	Unit 4	Introduction to Statistical signal processing	

6. Text Book/ References: J G Proakis, Digital Signal Processing, 3rd edition PHI, 2010

1. **Name of the Course**: **Optical Communication**
2. **LTP structure of the course**: **2-0-1**
3. **Objective of the course:** To let the Six Semester B. Tech. (ECE) students exposed to basic laws of optical communication and to demonstrate their application on optical devices
4. **Outcome of the course:** The students will learn how to handle optical systems.
5. **Course Plan:** As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	**Unit 1**	Optical sources and transmitters	
	Unit 2	Optical detectors and receivers	
Component 2	**Unit 3**	Optical Components	
	Unit 4	Optical Amplifiers and Point-to-point optical link design	

6. **Text Book:**
G. Keiser,Optical Fiber Communications, McGraw Hill, 1999

7. **References**:
J. M. Senior, Optical Fiber Communications, Pearson Education, 2000
R. Gagliardi and S. Karp, Optical Communications, TMH, 1990
J Gowar, Optical Communications System, Prentice Hall of India, 2000.

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1. Name of the Course: Principles of Wireless Communication
2. LTP structure of the course: 2-1-1
3. Objective of the course:
To enable the student to synthesis and analyze wireless and mobile cellular communication systems over a stochastic fading channel
To provide an understanding of advanced multiple access techniques and diversity reception techniques
To give an understanding of future wireless communication systems
4. Outcome of the course:
By the end of the course, the student will be able to analyze and design wireless and mobile cellular systems.
By the end of the course, the student will have the ability to work in advanced research wireless and mobile cellular programs.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Fundamentals of cellular Networks, Frequency reuse; handoff; co-channel interference	
	Unit 2	Multipath Fading; Characteristics of fading channel; Diversity Techniques.	
Component 2	Unit 3	Code Division Multiple Access (CDMA); Orthogonal Frequency Division Multiplexing (OFDM); LTE Networks	
	Unit 4	Cooperative Communication, Relaying Networks, Cognitive Radio Networks.	

6. Text Book:
T. S. Rappaport, Wireless Communications: 2nd ed. Principles and Practice, Pearson Education India, 2009
D. Tse and P. Viswanath, Fundamentals of Wireless Communications, Cambridge University Press, 2005

7. References:
A. B. Carlson, P. B. Crilly, and J. C. Rutledge, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, 4th ed. McGraw Hill, 2002.
L. Song and J. Shen, Evolved Cellular Networks planning and optimization for UMTS and LTE, 1st ed. CRC Press, 2010.
Y.-W. P. Hong, W.-J.Huang, C.-C. Jay Kuo, Cooperative Communications and Networking: Technologies and System Design, 1st ed. Springer, 2010.

Electives: As may be decided by the ECE deptt for VI semester

Course details for SOME of the electives for VI Semester

1. Name of the Course: Testing and Verification
2. LTP structure of the course: 3–1–0
3. Objective of the course: To make students familiar with fundamentals of Testing and Verification
4. Outcome of the course: Students will be able to solve industry standard problems in T and V.
5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Faults**: Physical FaultsDeductive, Parallel and Concurrent Fault Simulation, ATPG for Combinational Circuits	
	Unit 2	**ATPG for Sequential Circuits**: Time Frame Expansion; Controllability and Observability Scan Design; BIST.	
Component 2	Unit 3	**PLA Testing**: Cross Point Fault Model and Test Generation, Memory Testing: Pattern Sensitive Faults; Marching Tests.	
	Unit 4	**Verification**: Design verification techniques based on simulation, analytical and formal approaches, Functional verification, Timing verification, Formal verification, Basics of equivalence checking.	

6. Text Book:
M Bushnell, and V D Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Kluwer Academic (2000).

M Abramovici, M A Breuer, and A D Friedman, Digital Systems Testing and Testable Design, Jaico Publishing House (2001)

VLSI Test Principles and Architectures: Design for Testability. Edited by Laung-Terng Wang, Cheng-Wen Wu, and Xiaoqing Wen (2006)

T Kropf, Introduction to Formal Hardware Verification, Springer Verlag (1999)

7. References: As prescribed by Faculty

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1. Name of the Course: Hardware Design Methodology
2. LTP structure of the course: 3–1–0
3. Objective of the course: To make students familiar with fundamentals of Hardware Design and Methodology.
4. Outcome of the course: Students will be able to solve industry standard problems in power electronics.
5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Various abstraction levels for hardware design, Introduction to commercial technology design kits, EDA tools, RTL-GDSII	
	Unit 2	Design Methods: Design techniques for analog integrated circuits and systems, Design techniques, Integration issues,	
Component 2	Unit 3	Techniques to improve performance; Analysis and Optimization: Speed, Power and Area; Low power design	
	Unit 4	Frontend, Backend Design: RTL and GATE level modeling for digital systems, Logic design and synthesis, Placement.	

6. Text Book:

N. Zainalabedin. Verilog digital system design.McGraw-Hill, 1999.
K Martin and D Johns, Analog Integrated Circuit Design, April 2012.
W. Wayne. FPGA-based system design.Pearson education, 2004.

7. References: As prescribed by Faculty

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1. Name of the Course: Detection and Estimation Theory
2. LTP structure of the course: 3-1-0
3. Objective of the course:

a. To acquire the fundamental concepts of Signal Detection and Estimation
b. To get familiarize with different Hypotheses in detection and estimation problems
c. To familiarize with the detection and estimation of random signals.

4. Outcome of the course:

a. Acquire basics of statistical decision theory used for signal detection and estimation.
b. Comprehend the elements and structure of nonparametric detection.
c. Examine the performance of signal parameters using optimal estimators.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Bayes Risk Criterion, ML Criterion, N-P Criterion, Probability of Error Criterion, Max-Min Criterion.	
	Unit 2	Composite Hypothesis, Sequential Detection. General Gaussian Problem, Erasure Decision Problems.	
Component 2	Unit 3	ML Estimation, Bayes Cost Methods, CRLB, Multiple Parameter Estimation, Best Linear Unbiased Estimator	
	Unit 4	Linear Minimum-Variance and Least Square Methods, Kalman Filter, Miscellaneous Estimation Techniques	

6. Text Book:
H. L. Van Trees, Detection, Estimation and Modulation Theory (Part I), John Wiley & Sons, 2001, ISBN: 978-0471095170.

7. References:
S. M. Kay, Fundamentals of Statistical Signal Processing - Estimation Theory (Vol. 1), Prentice-Hall, Inc., 1993, ISBN: 978-0133457117.

H. V. Poor, An Introduction to Signal Detection and Estimation, (2nd edition), Springer, 2010, ISBN: 978-1441928375.

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1. Name of the Course: **Spintronic and Magnetic Materials**

2. **LTP structure** of the course: 3-1-0
3. **Objective of the course:** To expose the B. Tech students to magnetic materials and its applications in future technology.
4. **Outcome of the course:** Students will be able to understand use of magnetic materials/spintronics in device application. They will also able to calculate magnetic moment trough theoretical calculation by programming.
5. **Course Plan:**

Component	Unit	Topics for Coverage
Component -1	Unit 1	Introduction, The Origin of Atomic Moments, Paramagnetism of Free Ions, The Magnetically Ordered State, Crystal Fields, Diamagnetism, Itinerant-Electron Magnetism, Exchange interactions

	Unit 2	Measurement Techniques, Caloric Effects in Magnetic Materials, Permanent Magnets, High-Density Recording Materials, Soft-Magnetic Materials
Component -2	Unit 3	relaxation mechanisms, Spin relaxation mechanisms, The spin Galvanic effect, Basic electron transport, Spin-dependent transport, Spin dependent tunneling, Basic theory of Andreev reflections, Point-Contact Andreev Reflection, Ferromagnet/Superconductors/Ferromagnet double junctions, crossed Andreev reflections, Intuitive picture of spin-transfer torques, spin-transfer drive magnetic dynamics, Current-driven switching of magnetization and domain wall motion, Domain wall scattering and Current-Induced switching in ferromagnetic wires.
	Unit 4	Spin injection, spin accumulation, and spin current, Spin hall effect, Silicon based spin electronic devices, Spin LEDs: Fundamental and applications, Spin photoelectronic devices based on Heusler alloy, Electron spin filtering, Monolithic and Hybrid Spintronics, Materials for spin electronics, Nanostructures for spin electronics, Deposition techniques, micro and nanofabrication techniques. Spin-Valve and spin-tunneling devices: Read Heads, MRAMS, Field Sensors, Spintronic Biosensors, Quantum Computing with spins.

6. **Text Book:**

1. Physics of Magnetism and Magnetic Materials by K. H. Buschow and F R de Boer
2. Introduction to solid state physics by Charles Kittel
3. Introduction to magnetic materials by B. D. Cullity and C D Graham
4. S. Bandyopadhyay, M. Cahay, Introduction to Spintronics, CRC Press, 2008.
5. M. Johnson, Magnetoelectronics, Academic Press 2004.
6. D. J. Sellmyer, R. Skomski, Advanced Magnetic Nanostructures, Springer, 2006.
7. S. Maekawa, Concepts in Spin Electronics, Oxford University Press, 2006.
8. D.D. Awschalom, R.A. Buhrman, J.M. Daughton, S.V. Molnar, and M.L. Roukes, Spin Electronics, Kluwer Academic Publishers, 2004.
9. Y.B. Xu and S.M.Thompson, Spintronic Materials and Technology, Taylor & Francis, 2006
10. The magnetocaloric effect and its applications by A M Tishin and Y I Spichkin

Mini Project of VIthSem: Guidelines as decided by Deptt of ECE

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VII SEMESTER

Minor Project: Guidelines as decided by theDeptt of ECE as decided on Semesterly Basis every Year

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Electives: As decided by the ECE deptt for VII semester

Course details for SOME of the electives

1. Name of the Course: MIMO Communications
2. LTP structure of the course: 2-1-1
3. Objective of the course:

d. To acquire the fundamental concepts of MIMO wireless communications
e. To get familiarize with different MIMO receivers
f. To familiarize with the multi-user MIMO concepts.

4. Outcome of the course:

d. Acquire basics of spatial diversity used for wireless communication systems.
e. Understand the space-time block codes and the estimation of MIMO channels.
f. Examine the BER performance of MIMO Systems

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Modeling of wireless systems under fading channels Diversity techniques in wireless communication.	
	Unit 2	MIMO system model, Alamouti and Space-Time Codes, OSTBC codes, Estimation in MIMO Channel	
Component 2	Unit 3	MIMO Beamforming, MIMO Zero-Forcing Receiver, MIMO MMSE receiver, SVD of MIMO channel	
	Unit 4	Nonlinear MIMO Receiver, single -user MIMO, multi-user MIMO, MIMO relying	

6. Text Book:
D. Tse and P. Viswanath, Fundamentals of Wireless Communications, Cambridge University Press, 2005

7. References:
J. R. Hampton, Introduction to MIMO Communications, Cambridge University Press., 2013, ISBN: 9781107042834.

R.K. Kshetrimayum, Fundamentals of MIMO Wireless Communications, 1st ed. Cambridge University Press, 2017, ISBN: 9781108415699

1. Name of the Course: Radar and Satellite Communication
2. LTP structure of the course: 2-1-1
3. Objective of the course: To let the 7th Semester B. Tech. (ECE) students exposed to the terminology of Ranging, Detection and Space Communication.
4. Outcome of the course: The students will learn how to handle the Space Communication
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Radar Range Equation and its Analysis	
	Unit 2	CW, FM, MTI, PDR and Tracking Radar	
Component 2	Unit 3	Orbital aspects of Satellite communication and Satellite Transponder	
	Unit 4	Satellite Channel, Link design and Multiple-Access System	

6. Text Book:
M. I. Skolnik, Introduction to Radar Systems, Wiley, 2000
T. Pratt, C. W. Boston & J. E. Allnutt, Satellite Communication, Wiley, 2000
R. M. Gagliardi, Satellite Communication, Wiley, 2000

1. Name of the Course: Photonic Crystals and Metamaterials
2. **LTP structure of the course:** 2–1–1
3. **Objective of the course: SAME AS Appl. Sc. Department**
4. **Outcome of the course: SAME AS Appl. Sc. Department**
5. **Course Plan:**

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction of Principles and Properties of Photonic Crystals, Fabrication techniques of 1-D, 2-D and 3-D photonic Crystals	
	Unit 2	Photonic Crystal All optical Switching, Tunable Photonic Crystal Filter, Photonic crystal laser, Dielectric Photonic Crystal laser, Photonic Crystal Logic devices, Photonic Crystals Sensors.	
Component 2	Unit 3	Metamaterials with Negative Material, parameters, Negative Refraction and Photonic Bandgap Materials, Media, Theory and Properties , Energy and Momentum in Negative Refractive Index Materials, Plasmonics of Media with Negative Material Parameters	
	Unit 4	Veselago's Lens, Designing Super Lenses, Brief Report on Electromagnetic Invisibility, Cloaking with localized resonances. Mathematical calculations for - The Reflection and Refraction of Light across a Material Slab, The Dispersion and Fresnel Coefficients for a Bianisotropic Medium, The Fresnel Coefficients for Reflection and Refraction	

6. Text Book/References:-

1. Photonic Crystals: Principles and Applications by Qihuang Gongn Xiaoyong Hu, CRC Press 2014
2. 2.Physics and Applications of Negative refractive Index Materials, by S Ananth Ramakrishna,T M Grzegorcryk, CRC Press 2008
3. 3.Photonic Crystals: The Road from Theory to Practice by John D. Joannopoulos and Steven G. Johnson, Abe books, 2002
4. Photonic Crystals by Abebe Demoz, VDM Verlag, ISBN: 9783639325591, 3639325591, Edition: 2011
5. 5.Optical Properties Of Photonic Crystals, by Jorell Hill and Derrick Miller, Publisher - Delve, ISBN: 1680952064
6. 6.Photonic Crystals: Molding the Flow of Light, by J D Joannopoulos, 1995
7. 7.Photonic Crystals: Towards Nanoscale Photonic Devices by Alexei Tchelnokov, Daniel Maystre, Henri Benisty, Jean-Michel Gerard, Jean-Michel Lourtioz, and Vincent Berger , Springer, 2005
8. 8.Fundamentals of Photonic Crystal Guiding by Jianke Yang and Maksim Skorobogatiy, Cambridge Press, 2008
9. 9.Photonic Crystals: Advances in Design, Fabrication, and Characterization Edited by Kurt Busch, Ralf Wehrspohn, Stefan Lolkes, Wiley-VCH, 2004

VIII SEMESTER

Major Project: Guidelines as decided by the Deptt of ECE

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Electives: As decided by the ECE deptt for VIII semester

Course details for an INDICATIVE ELECTIVE

BTECH REGULAR COMPLETE

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Scheme for B.Tech.withSpecialisations / ADD ONs / Certifications

Add-ONs offered by the ECE department on Guidelines as specified in Ordinance

(All Courses carry 4 Credit)

ADD-ON Specialization on … (For B.Tech. (ECE) students)	ADD-ON Minor on … (For B. Tech. (IT) students)
1. Advanced Wireless Communications i. Detection and Estimation Theory ii. Cooperative Cognitive Communication iii. Wireless Sensor Networks iv. Security and Authentication in Wireless Networks v. Wireless Power Transfer Techniques vi. MIMO Radar Systems vii. Digital Signal Processing Applications in Wireless Networks viii. Any other suitable elective as may be floated by the department ix. Project (in the Transit Semester)	**1. Wireless Communications** i. Principles of Wireless Communications (Core) ii. Detection and Estimation Theory iii. Cooperative Cognitive Communication iv. Wireless Sensor Networks v. Security and Authentication in Wireless Networks vi. Wireless Power Transfer Techniques vii. MIMO Radar Systems viii. Digital Signal Processing Applications in Wireless Networks ix. Any other suitable elective as may be floated by the department x. Project (in the Transit Semester)
2. Applications of the Information Theory i. Advanced Information Theory ii. Advanced Error Control Coding iii. Data Encryption Techniques iv. Data Compression Techniques v. Statistical Digital Signal Processing and Modeling vi. Any other suitable elective as may be floated by the department vii. Project (in the Transit Semester)	**3. Digital Signal Processing** i. Discrete time Signals and Systems (Core) ii. Digital Signal Processing (Core) iii. Digital Signal Processors iv. Codec Designs v. Statistical Digital Signal Processing and Modeling vi. Any other suitable elective as may be floated by the department vii. Project (in the Transit Semester)
3. Advanced Embedded System i. Advance Embedded System ii. FPGA based system design iii. RTOS iv. Embedded System for Wireless Communication v. Embedded System Testing vi. Control of Embedded System vii. Any other suitable elective as may be floated by the department viii. Project (in the Transit Semester)	**3. Embedded System** i. Digital IC Design (core) ii. Verilog Programming (core) iii. System On Chip (SOC) iv. Advance Embedded System v. Embedded System Testing vi. Testing & Verification vii. Hardware Design Methodology viii. Control of Embedded System x. Any other suitable elective as may be floated by the department xi. Project (in the Transit Semester)
4. Advanced VLSI Design i. FPGA Archetecture& Application ii. EDA iii. Solid State Devices iv. VLSI Signal Processing v. MEMS Technology vi. RF & IC Design ix. Any other suitable elective as may be floated by the department x. Project (in the Transit Semester)	**4. VLSI Design** i. Verilog Programming ii. Introduction to Custom IC Design iii. VLSI Technology iv. Digital IC Design (core) v. Analog IC Design (core) vi. Mixed Signal Design viii. Any other suitable elective as may be floated by the department ix. Project (in the Transit Semester)
5. Advanced Nano electronics devices and technology i. Advanced Lithography ii. Physics of nano Materials iii. Fundamentals of Nanoscale Devices iv. Quantum Electronics v. Advanced Engineering Mathematics vi. Materials for Energy Harvesting vii. Any other suitable elective as may be floated by the department	**5. Nano electronics devices and technology** i. VLSI Technology (core) ii. MEMS (core) iii. Advanced Lithography iv. Physics of nano Materials v. Fundamentals of Nanoscale Devices vi. Materials for Energy Harvesting vii. Any other suitable elective as may be floated by the department viii. Project (in the Transit Semester)

viii. Project (in the Transit Semester)	
6. AdvancedInstrumentation and Control i. Modern Control Systems ii. Non Conventional energy Sources iii. Sensors and Sensor Networks iv. Advanced Medical Instrumentation v. Robust Control System vi. Intelligent Control System vii. Embedded Control System viii. Networked Control System xii. Digital Control System xiii. Any other suitable elective as may be floated by the department xiv. Project (in the Transit Semester)	6. **Instrumentation and Control** i. Electronic Measurement & Instrumentation (core) ii. Control System (core) iii. Digital Control System iv. Modern Control Systems v. Sensors and Sensor Networks vi. Advanced Medical Instrumentation vii. Embedded Control System viii. Networked Control System ix. Any other suitable elective as may be floated by the department x. Project (in the Transit Semester)
7. Advanced RF and Microwave Engineering i. Advanced Electromagnetics ii. Advanced Antenna Design and Measurements iii. Microwave Circuits iv. Tools for Microwave Measurement and Design v. Smart Antennas vi. Principles of Microwave Remote Sensing for Environmental Applications vii. Modern Trends in Microwave Engineering viii. Any other suitable elective as may be floated by the department Project (in the Transit Semester	**7. RF and Microwave Engineering** i. Electromagnetic Field and Wave (core) ii. Antenna and Wave Propagation (Core) iii. Solid State Microwave Devices iv. Tools for Microwave Measurement and Design v. Principles of Microwave Remote Sensing for Environmental Applications vi. Modern Trends in Microwave Engineering vii. Any other suitable elective as may be floated by the department Project (in the Transit Semester) To be submitted later
8. Photonics i. Optical Electronics ii. Guided Optical Component and Devices iii. Optical Communication systems iv. CMOS photonics v. Optical Networks vi. Photonics Sensors vii.Any other suitable elective as may be floated by the department Project (in the Transit Semester)	**8. Photonics** i. Optical Electronics ii. Guided Optical Component and Devices iii. Optical Communication systems iv. CMOS photonics v. Optical Networks vi. Photonics Sensors vii.Any other suitable elective as may be floated by the department Project (in the Transit Semester)
Notes: 1. While offering aAdd-ON Certification, for students of B.Tech. IT, the Courses marked in Green are treated as CORE Courses.	

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ADD-ON Specialization on Advanced Wireless Communications
(For B. Tech., ECE Students)

Detection and Estimation Theory

Name of the Course: Detection and Estimation Theory
2. LTP structure of the course: 2-1-1
3. Objective of the course:

g. To acquire the fundamental concepts of Signal Detection and Estimation
h. To get familiarize with different Hypotheses in detection and estimation problems
i. To familiarize with the detection and estimation of random signals.

4. Outcome of the course:

g. Acquire basics of statistical decision theory used for signal detection and estimation.
h. Comprehend the elements and structure of nonparametric detection.
i. Examine the performance of signal parameters using optimal estimators.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Bayes Risk Criterion, ML Criterion, N-P Criterion, Probability of Error Criterion, Max-Min Criterion.	
	Unit 2	Composite Hypothesis, Sequential Detection. General Gaussian Problem, Erasure Decision Problems.	
Component 2	Unit 3	ML Estimation, Bayes Cost Methods, CRLB, Multiple Parameter Estimation, Best Linear Unbiased Estimator	
	Unit 4	Linear Minimum-Variance and Least Square Methods, Kalman Filter, Miscellaneous Estimation Techniques	

6. Text Book:

H. L. Van Trees, Detection, Estimation and Modulation Theory (Part I), John Wiley & Sons, 2001, ISBN: 978-0471095170.

7. References:

S. M. Kay, Fundamentals of Statistical Signal Processing - Estimation Theory (Vol. 1), Prentice-Hall, Inc., 1993, ISBN: 978-0133457117.

H. V. Poor, An Introduction to Signal Detection and Estimation, (2nd edition), Springer, 2010, ISBN: 978-1441928375.

1. Name of the Course: Cooperative Cognitive Communications
2. LTP structure of the course: 2:1:1
3. Objective of the course: This course is intended to give thefoundations of cooperative cognitive communications. The course helps the students to learn the basics of cognitive radio, spectrum sensing. multiuser diversity, proportional fair scheduling, opportunistic beamforming,relaying strategies in cooperative cellular networks.
4. Outcome of the course:To provide an overall understanding of cooperative Cognitive Communications.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction to Cognitive Radio:Cognitive Radio Framework, Functions and Paradigms	
	Unit 2	Spectrum Sensing: Matched Filtering (Coherent Detector), Energy Detector, etc.	
Component 2	Unit 3	Opportunistic Communications, CooperativeCommunications	
	Unit 4	Relaying Strategies in Cooperative Cellular Networks	

6. Text Book:

a. Cooperative cognitive radio networks: the complete spectrum cycle, Mohamed Ibnkahla, CRC Press, 2015.
b. Advanced Wireless Networks: Cognitive, Cooperative and Opportunistic 4G Technology, SavoGlisic, Beatriz Lorenzo,John Wiley & Sons Ltd., Second Edition, 2009.

7. References:

a. Cognitive Radio Networks: Efficient Resource Allocation in Cooperative Sensing, Cellular Communications, High-Speed Vehicles, and Smart Grid, Tao Jiang, Zhiqiang Wang, Yang Cao, CRC Press, 2015.
b. Advanced wireless networks:Cognitive, cooperative and opportunistic 4G technology, SavoGlisic, Beatriz Lorenzo, John Wiley & Sons Ltd., Second Edition, 2007.

1. Name of the Course: Wireless Sensor Networks

2. LTP structure of the course: 2:1:1

3. Objective of the course: This informative course describes how to build wireless sensor networks from the layers of communication protocol through the design of network nodes. The syllabus is more than just a survey of the basics of wireless sensor networks.

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4. Outcome of the course: To provide an overall picture and working principles of wireless sensor networks.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	1 Introduction, Architectures (Single node, Network Architecture), WSN applications and Factors	
	Unit 2	Communication Protocols, Cross-layer Designs.	
Component 2	Unit 3	Naming and addressing, Time Synchronization, Routing	
	Unit 4	Localization, Topology Management, Advanced application	

6. Text Book:

a. Protocols and Architectures for Wireless Sensor Networks, Holger Karl and Andreas Willig.

b. Wireless Sensor Networks: principles and Practice, Fei Hu and Xiaojun Cao.

c. Handbook of Sensor Networks: Mohammad IIyas and ImadMahgoub.

7. References:

c. Wireless sensor Networks: Architectures and Protocols, Edgar H. Callaway, 2004.

d. Wireless sensor Network, Ian F. Akyildiz and Mehmet Can Vuran, 2010.

e. Wireless Sensor networks, IEEE.

Security and Authentication in Wireless Networks

1. Name of the Course: Security and Authentication in Wireless Networks
2. LTP structure of the course: 2:1:1
3. Objective of the course: This course is intended to be the text for a course in security and authentication aspects of wireless networks. It is partitioned into four parts. The first part gives a brief introduction of various security vulnerabilities at different layers of protocol stack and secrecy performance measures. Second part discusses the secrecy aspects of WLANs, security vulnerabilities at application and transport layers, and secrecy issues for the voice traffic. Finally security issues in Ad-Hoc and sensor network, machine to machine networks, mesh networks and multi-hop networks are being discussed
4. Outcome of the course: This course will create awareness about the different vulnerabilities which are there at different layers for a wireless network. It will also empower the learn different techniques by which secrecy threats can be mitigated so as to ensure that the key aspects for information secrecy that is authenticity, integrity, confidentiality are not violated.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction: Wireless Information Warfare: threats and attacks at different layers, Cryptographic attacks	
	Unit 2	Securing WLANs, Security status of wireless application protocol (WAP), Voice network security.	
Component 2	Unit 3	Security in Wireless Ad-Hoc Networks: Security attack detection, Security and privacy for routing protocols	
	Unit 4	Security issues in Machine to Machine communication, networks, Authentication in wireless mesh networks	

7. Text Book:

1. Wireless Security. Nichols, Randall K, PanosLekkas, and PanosC.Lekkas. McGraw-Hill Professional Publishing, 2001.
2. Security for Multihop Wireless Networks. Khan, Shafiullah, and Jaime LloretMauri, eds. CRC Press, 2014.

8. References:

1. Wireless Networks and Security. Khan, Shafiullah, and A. Khan Pathan. Berlin: Springer, 2013.
2. Security without Obscurity: A Guide to PKI Operations. Stapleton, Jeff, and W. Clay Epstein. CRC Press, 2016.
3. Wireless Internet Security: Architecture and Protocols. Kempf, James. Cambridge University Press, 2008.

Wireless Power Transfer Techniques

1. Name of the Course: Wireless Power Transfer Techniques
2. LTP structure of the course: 2:1:1
3. Objective of the course: This course is intended to provide the foundation of the WPT including system architecture, RF wireless power transfer techniques and existing applications. The idea of WPT is exploited in emerging areas such as full duplex communication; cooperative wireless communications, interference exploitation, etc. are to be discussed. WPT/SWIPT applications of WSNs are also to be covered in this course.
4. Outcome of the course: This course aims at bringing and structuring the state-of-the-art research findings in WPT/SWIPT and presenting these to students.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Wireless Information and Power Transfer, Energy Harvesting for Wireless Relaying Systems	
	Unit 2	Energy Harvesting Protocols For Wireless Sensor Efficient Wireless Power Transfer Maximization schemes	
Component 2	Unit 3	Trade-Offs in Wireless Powered Communications, Simultaneous WPT and Wireless Communication	
	Unit 4	Mobility in Wireless Sensor Networks with Wireless Power Transfer	

6. Text Book:

1. Wireless Information and Power Transfer: A New Paradigm for Green Communications, DushanthaNalin K. Jayakody, John Thompson, SymeonChatzinotas, Salman Durrani, Springer, 2017.
2. Wireless Power Transfer Algorithms, Technologies and Applications in Ad Hoc Communication Networks, Sotiris Nikoletseas, Yuanyuan Yang, ApostolosGeorgiadis , Springer International Publishing, 2017.

7. References:

1. Wireless Power Transfer via Radiowaves , Shinohara, Naoki, Wiley-ISTE, 2014.

MIMO Radar Systems

1. Name of the Course: MIMO Radar Systems

2. LTP structure of the course: 2-1-1
3. Objective of the course: To acquire the fundamental concepts of MIMO Radar communications and its applications.

4. Outcome of the course: The students will understand the concepts of signal processing in MIMO Radar systems

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Fundamentals of Radar, MIMO Radar: Concepts, Performance Enhancements, and Applications	
	Unit 2	Generalized MIMO Radar Ambiguity Functions, Target Localization Using MIMO Radars	
Component 2	Unit 3	Adaptive Signal Design for MIMO Radars	
	Unit 4	MIMO Distributed Radar System	

6. Text Book/ References:-

1. J. LI and P. Stoica, *MIMO Radar Signal Processing*, John Wiley and Sons, 2009

Digital Signal Processing Applications in Wireless Networks

1. **Name of the Course**: Digital Signal Processing Applications in Wireless Networks

2. **LTP structure of the course**: 2-1-1

3. **Objective of the course**: To learn about the advanced topics in the field of Digital Signal Processing.

4**. Outcome of the course**: Student will learn to utilize the advanced approaches of processing the signals and various aspects of discrete system design.

5. **Course Plan**: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Review of the fundamental concepts of digital signal processing, DFT and FFT	
	Unit 2	The structures for realization of FIR and IIR systems and their analysis.	
Component 2	Unit 3	Multirate Signal processing and polyphase filtering	
	Unit 4	Statistical signal processing, applications of autoregressive (AR), Moving Average (MA), ARMA processes	

6. Text Book:-

1. S. K. Mitra, Digital Signal Processing: A Computer-Based Approach, McGraw-Hill International Editionsseries , 2001.
2. Dimitris G Manolakis, John G. Proakis,:Digital Signal Processing : Principles, Algorithms, and Applications,Pearson, Edition- 4

7. References:-

1. Oppenheim, Schafer :Discrete-Time Signal Processing, Pearson, Edition- 3

2. Richard G.Lyons:Understanding Digital Signal Processing, Pearson, Edition-3

ADD-ON Minor on Wireless Communications
(For B. Tech., IT Students)

Principles of Wireless Communications (Core)

1. Name of the Course: Detection and Estimation Theory
2. LTP structure of the course: 2-1-1
3. Objective of the course:

j. To acquire the fundamental concepts of Signal Detection and Estimation
k. To get familiarize with different Hypotheses in detection and estimation problems
l. To familiarize with the detection and estimation of random signals.

4. Outcome of the course:

j. Acquire basics of statistical decision theory used for signal detection and estimation.
k. Comprehend the elements and structure of nonparametric detection.
l. Examine the performance of signal parameters using optimal estimators.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Bayes Risk Criterion, ML Criterion, N-P Criterion, Probability of Error Criterion, Max-Min Criterion.	
	Unit 2	Composite Hypothesis, Sequential Detection. General Gaussian Problem, Erasure Decision Problems.	
Component 2	Unit 3	ML Estimation, Bayes Cost Methods, CRLB, Multiple Parameter Estimation, Best Linear Unbiased Estimator	
	Unit 4	Linear Minimum-Variance and Least Square Methods, Kalman Filter, Miscellaneous Estimation Techniques	

6. Text Book:

H. L. Van Trees, Detection, Estimation and Modulation Theory (Part I), John Wiley & Sons, 2001, ISBN: 978-0471095170.

7. References:

1. S. M. Kay, Fundamentals of Statistical Signal Processing - Estimation Theory (Vol. 1), Prentice-Hall, Inc., 1993, ISBN: 978-0133457117.

2. H. V. Poor, An Introduction to Signal Detection and Estimation, (2nd edition), Springer, 2010, ISBN: 978-1441928375.

Detection and Estimation Theory

1. Name of the Course: Detection and Estimation Theory
2. LTP structure of the course: 2-1-1
3. Objective of the course:

1. To acquire the fundamental concepts of Signal Detection and Estimation
2. To get familiarize with different Hypotheses in detection and estimation problems
3. To familiarize with the detection and estimation of random signals.

4. Outcome of the course:

1. Acquire basics of statistical decision theory used for signal detection and estimation.
2. Comprehend the elements and structure of nonparametric detection.
3. Examine the performance of signal parameters using optimal estimators.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Bayes Risk Criterion, ML Criterion, N-P Criterion, Probability of Error Criterion, Max-Min Criterion.	
	Unit 2	Composite Hypothesis, Sequential Detection. General Gaussian Problem, Erasure Decision Problems.	
Component 2	Unit 3	ML Estimation, Bayes Cost Methods, CRLB, Multiple Parameter Estimation, Best Linear Unbiased Estimator	
	Unit 4	Linear Minimum-Variance and Least Square Methods, Kalman Filter, Miscellaneous Estimation Techniques	

6. Text Book:

H. L. Van Trees, Detection, Estimation and Modulation Theory (Part I), John Wiley & Sons, 2001, ISBN: 978-0471095170.

7. References:

S. M. Kay, Fundamentals of Statistical Signal Processing - Estimation Theory (Vol. 1), Prentice-Hall, Inc., 1993, ISBN: 978-0133457117.

H. V. Poor, An Introduction to Signal Detection and Estimation, (2nd edition), Springer, 2010, ISBN: 978-1441928375.

1. Name of the Course: Cooperative Cognitive Communications
2. LTP structure of the course: 2:1:1
3. Objective of the course: This course is intended to give thefoundations of cooperative cognitive communications. The course helps the students to learn the basics of cognitive radio, spectrum sensing. multiuser diversity, proportional fair scheduling, opportunistic beamforming,relaying strategies in cooperative cellular networks.
4. Outcome of the course:To provide an overall understanding of cooperative Cognitive Communications.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction to Cognitive Radio:Cognitive Radio Framework, Functions and Paradigms	
	Unit 2	Spectrum Sensing: Matched Filtering (Coherent Detector), Energy Detector, etc.	
Component 2	Unit 3	Opportunistic Communications, CooperativeCommunications	
	Unit 4	Relaying Strategies in Cooperative Cellular Networks	

6. Text Book:

c. Cooperative cognitive radio networks: the complete spectrum cycle, Mohamed Ibnkahla, CRC Press, 2015.
d. Advanced Wireless Networks: Cognitive, Cooperative and Opportunistic 4G Technology, SavoGlisic, Beatriz Lorenzo,John Wiley & Sons Ltd., Second Edition, 2009.

7. References:

c. Cognitive Radio Networks: Efficient Resource Allocation in Cooperative Sensing, Cellular Communications, High-Speed Vehicles, and Smart Grid, Tao Jiang, Zhiqiang Wang, Yang Cao, CRC Press, 2015.
d. Advanced wireless networks:Cognitive, cooperative and opportunistic 4G technology, SavoGlisic, Beatriz Lorenzo, John Wiley & Sons Ltd., Second Edition, 2007.

Wireless Sensor Networks

1. Name of the Course: Wireless Sensor Networks
2. LTP structure of the course: 2:1:1
3. Objective of the course: This informative course describes how to build wirelesssensornetworksfrom the layers of communication protocol through the design of network nodes. The syllabus is morethan just a survey of the basics of wireless sensor networks.
4. Outcome of the course: To provide an overall picture and working principles of ireless sensornetworks.
5. Course Plan:As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction, Architectures (Single node, NetworkArchitecture), WSN applications and Factors	
	Unit 2	Communication Protocols, Cross-layer Designs	
Component 2	Unit 3	Naming and addressing, Time Synchronization, Routing	
	Unit 4	Localization, Topology Management, Advancedapplication	

6. Text Book:
a. Protocols and Architectures for Wireless Sensor Networks, Holger Karl and Andreas Willig.
b. Wireless Sensor Networks: principles and Practice, Fei Hu and Xiaojun Cao.
c. Handbook of Sensor Networks: Mohammad Ilyas and ImadMahgoub.
7. References:
c. Wireless sensor Networks: Architectures and Protocols, Edgar H. Callaway, 2004.
d. Wireless sensor Network, Ian F. Akyildiz and Mehmet Can Vuran, 2010.
e. Wireless Sensor networks, IEEE.

Security and Authentication in Wireless Networks

1. Name of the Course: Security and Authentication in Wireless Networks
2. LTP structure of the course: 2:1:1
3. Objective of the course: This course is intended to be the text for a course in security and authentication aspects of wireless networks. It is partitioned into four parts. The first part gives a brief introduction of various security vulnerabilities at different layers of protocol stack and secrecy performance measures. Second part discusses the secrecy aspects of WLANs, security vulnerabilities at application and transport layers, and secrecy issues for the voice traffic. Finally security issues in Ad-Hoc and sensor network, machine to machine networks, mesh networks and multi-hop networks are being discussed
4. Outcome of the course: This course will create awareness about the different vulnerabilities which are there at different layers for a wireless network. It will also empower the learn different techniques by which secrecy threats can be mitigated so as to ensure that the key aspects for information secrecy that is authenticity, integrity, confidentiality are not violated.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction: Wireless Information Warfare: threats and attacks at different layers, Cryptographic attacks	
	Unit 2	Securing WLANs, Security status of wireless application protocol (WAP), Voice network security.	
Component 2	Unit 3	Security in Wireless Ad-Hoc Networks: Security attack detection, Security and privacy for routing protocols	
	Unit 4	Security issues in Machine to Machine communication, networks, Authentication in wireless mesh networks	

7. Text Book:

a. Wireless Security. Nichols, Randall K, PanosLekkas, and PanosC.Lekkas. McGraw-Hill Professional Publishing, 2001.
b. Security for Multihop Wireless Networks. Khan, Shafiullah, and Jaime LloretMauri, eds. CRC Press, 2014.

8. **References:**

a. Wireless Networks and Security. Khan, Shafiullah, and A. Khan Pathan. Berlin: Springer, 2013.
b. Security without Obscurity: A Guide to PKI Operations. Stapleton, Jeff, and W. Clay Epstein. CRC Press, 2016.
c. Wireless Internet Security: Architecture and Protocols. Kempf, James. Cambridge University Press, 2008.

Wireless Power Transfer Techniques

1. Name of the Course: Wireless Power Transfer Techniques
2. LTP structure of the course: 2:1:1
3. Objective of the course: This course is intended to provide the foundation of the WPT including system architecture, RF wireless power transfer techniques and existing applications. The idea of WPT is exploited in emerging areas such as full duplex communication; cooperative wireless communications, interference exploitation, etc. are to be discussed. WPT/SWIPT applications of WSNs are also to be covered in this course.
4. Outcome of the course: This course aims at bringing and structuring the state-of-the-art research findings in WPT/SWIPT and presenting these to students.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Wireless Information and Power Transfer, Energy Harvesting for Wireless Relaying Systems	
	Unit 2	Energy Harvesting Protocols For Wireless Sensor Efficient Wireless Power Transfer Maximization schemes	
Component 2	Unit 3	Trade-Offs in Wireless Powered Communications, Simultaneous WPT and Wireless Communication	
	Unit 4	Mobility in Wireless Sensor Networks with Wireless Power Transfer	

6. Text Book:

a. Wireless Information and Power Transfer: A New Paradigm for Green Communications, DushanthaNalin K. Jayakody, John Thompson, SymeonChatzinotas, Salman Durrani, Springer, 2017.
b. Wireless Power Transfer Algorithms, Technologies and Applications in Ad Hoc Communication Networks , Sotiris Nikoletseas, Yuanyuan Yang, ApostolosGeorgiadis , Springer International Publishing, 2017.

7. References:

c. Wireless Power Transfer via Radiowaves , Shinohara, Naoki, Wiley-ISTE, 2014.

MIMO Radar Systems

1. Name of the Course: MIMO Radar Systems

2. LTP structure of the course: 2-1-1
3. Objective of the course: To acquire the fundamental concepts of MIMO Radar communications and its applications.

4. Outcome of the course: The students will understand the concepts of signal processing in MIMO Radar systems

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Fundamentals of Radar, MIMO Radar: Concepts, Performance Enhancements, and Applications	
	Unit 2	Generalized MIMO Radar Ambiguity Functions, Target Localization Using MIMO Radars	
Component 2	Unit 3	Adaptive Signal Design for MIMO Radars	
	Unit 4	MIMO Distributed Radar System	

6. Text Book:
1. J. LI and P. Stoica, *MIMO Radar Signal Processing*, John Wiley and Sons, 2009

7. References:

Digital Signal Processing Applications in Wireless Networks

1. **Name of the Course**: Digital Signal Processing Applications in Wireless Networks

2. **LTP structure of the course**: 2-1-1

3. **Objective of the course**: To learn about the advanced topics in the field of Digital Signal Processing.

4**. Outcome of the course**: Student will learn to utilize the advanced approaches of processing the signals and various aspects of discrete system design.

5. **Course Plan**: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	Review of the fundamental concepts of digital signal processing, DFT and FFT	
	Unit 2	The structures for realization of FIR and IIR systems and their analysis.	
Component 2	Unit 3	Multirate Signal processing and polyphase filtering	
	Unit 4	Statistical signal processing, applications of autoregressive (AR), Moving Average (MA), ARMA processes	

6. Text Book:-

1. S. K. Mitra, Digital Signal Processing: A Computer-Based Approach, McGraw-Hill International Editionsseries , 2001.
2. Dimitris G Manolakis, John G. Proakis,:Digital Signal Processing : Principles, Algorithms, and Applications,Pearson, Edition- 4

7. References:-

1. Oppenheim, Schafer :Discrete-Time Signal Processing, Pearson, Edition- 3

2. Richard G.Lyons:Understanding Digital Signal Processing, Pearson, Edition-3

ADD-ON Specialization on Applications of the Information Theory
(For B. Tech., ECE Students)

Advanced Information Theory

1. Name of the Course: Advanced Information Theory and Coding

2. LTP structure of the course: 2-1-1

3. Objective of the course: To learn about the fundamental concepts and latest advancements in the field of information theory and error control coding.

4. Outcome of the course: Student will learn to use the knowledge of information theoretical approaches and coding techniques for designing various communication networks.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Review of fundamental concepts like Source coding, channel capacity, channel coding and decoding approaches.	
	Unit 2	Advanced error control codes	
Component 2	Unit 3	Principles of Network Coding: Analog and Digital	
	Unit 4	Applications of ITC in modern systems and physical layer security	

6. Text Book:

(a)Cover, T M and Thomas :Elements of Information Theory,New York-Wiley, 1991

(b)R. G. Gallager, Information Theory and Reliable Communication, Wiley, 1969

7. References:

(a)Shannon, C and Weaver, W: Mathematical Theory of Communication. Urbana: University of Illinois Press, 1949

(b)A. Khinchin :Mathematical foundations of information theory, Dover, 2001 edition.

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1. Name of the Course: Advanced Error Control Coding

2. LTP structure of the course: 2:1:1

3. Objective of the course: This course is intended to emphasize the fundamental concepts of coding theory while minimizing the use of mathematical tools, demonstrates the role of coding in communication system design, shows the performance gains achievable with coding techniques.

4. Outcome of the course: Illustrates how codes should be used and how to select the right code parameters, discusses the decoding techniques that should be considered and how they are implemented.

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Coding for reliable digital transmission,linear block code,cyclic code	
	Unit 2	BCH code, Major cyclic decodes, Finite geometry code	
Component 2	Unit 3	Burst error correcting code, Convolution code	
	Unit 4	Maximum likelihood decoding for convolution code.	

6. Text Book:

c. Error control coding its fundamentals and application Shulin and Daniel J Costello.
d. Error Control Systems for Digital Communication and Storage Stephen B Wicker.

7. References:

d. Error correcting code William wiesley Peterson.
e. Fundamental of Error correcting codes W carry Huffman.

1. Name of the Course: Data Encryption Techniques
2. LTP structure of the course: 2:1:1
3. Objective of the course: This course is intended to be the text for a course in data encryption where it introduces to various encryption techniques. It is partitioned into four parts starting from the basics of Encryption, Preliminary mathematics needed, Symmetric Ciphers and Hashes and lastly, Asymmetric Ciphers. Various encryption algorithms of both symmetric and asymmetric types like DES, AES, SHA, RSA and Diffie-Hellman are being discussed.
4. Outcome of the course:To provide an overall understanding of various data encryption techniques. The student will understand how an encryption algorithm is designed and the mathematics behind it. Besides this, the course will develop an understanding of the various encryption techniques like DES, AES, SHA, RSA, and Diffie-Hellman.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Basics of Encryption, Classical Ciphers and their working, Security Goals and Notions.	
	Unit 2	Essential Number Theory and Discrete Math, Information Security, Computational Security,	
Component 2	Unit 3	DES, P-Box S-Box design. Cryptographic Hashes: SHA	
	Unit 4	Asymmetric Ciphers: RSA, Diffie-Hellman. Applications: Key Exchange	

6. Text Book:

e. Modern Cryptography: Applied Mathematics for Encryption and Information Security. Chuck Easttom.McGraw-Hill Education, 2016.
f. The mathematics of encryption: An Elementary Introduction. Cozzens, Margaret, and Steven J. Miller. Vol. 29. American Mathematical Soc., 2013

7. References:

f. Algebraic Aspects of the Advanced Encryption Standard.Cid, Carlos, Sean Murphy, and Matthew Robshaw. Springer Science & Business Media, 2006.
g. Serious Cryptography: A Practical Introduction to Modern Encryption. Jean-Philippe Aumasson. No Starch Press.

1. Name of the Course: Data Compression Techniques
2. LTP structure of the course: 2:1:1
3. Objective of the course: This course provides an overview of classical and modern techniques and algorithms of various types data compression. It covers statistical and dictionary methods, lossless and lossy compression algorithms in graphics, video and audio compression.
4. Outcome of the course: Upon the successful completing the course student will be able to define compression, understand the idea of lossless and lossy compression and understand the most common file formats for image, sound and video.
5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction,Mathematical Preliminaries for Lossless Compression. Huffman codes and Arithmetic coding.	
	Unit 2	Dictionary Methods, Context based compression ,Mathematical Preliminaries for Lossy Coding	
Component 2	Unit 3	Scalar Quantization, Vector Quantization,Differential Encoding.	
	Unit 4	Introduction to transform and subband coding, wavelet based compression, audio and video compression standards.	

6. Text Book:

1. Introduction to Data Compression: Khalid Sayood and Morgan Kaufmann.

7. References:

1. Data Compression: Complete Reference, David Soloman, Springer- Verlag London.
2. Data Compression Techniques: IEEE and other research papers.

ADD-ON Minor on Digital Signal Processing
(For B. Tech., IT Students)

Discrete time Signals and Systems (Core)

1. Name of the Course: Discrete Time Signals and Systems
2. LTP structure of the course: 2-1-1
3. Objective of the course: To demonstrate an understanding of the fundamental properties of linear time invariant systems.
4. Outcome of the course: The student will learnto analyze the spectral characteristics of continuous-time and discrete-time signals using Fourier analysis.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Continuous-Time signals; Analysis of Continuous-Time LTI Systems; Review of Fourier and Laplace transforms	
	Unit 2	Discrete-Time Signals; Sampling; Analysis of Discrete-Time LTI Systems	
Component 2	Unit 3	Discrete Time Fourier Series; Discrete Time Fourier Transform and properties	
	Unit 4	Z-Transform and Its Application to the Analysis of LTI Systems and properties	

6. Text Book:
1. A. V. Oppenheim and R. W. Schafer, Discrete-Time Signal Processing, 2nd ed. Pearson Education, 2003.
2. J.G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 3rded Prentice-Hall, 1996.

7. References:
1. S. Haykin and B. V. Been, Signals and Systems 2nd Ed., John Wiley & Sons. 2003.
2. R.E. Ziemer, W.H. Tranter, and D.R. Fannin, Signals and Systems: Continuous and Discrete, 4th ed., Pearson Education, 2001.
3. B. P. Lathi, Linear Systems and Signals, 2nd ed., Oxford University Press, 2005.

Digital Signal Processing (Core)

1. Name of the Course: Digital Signal Processing

2. LTP structure of the course: 2-1-1

3. Objective of the course: To learn about the advanced topics in the field of Digital Signal Processing.

4. Outcome of the course: Student will learn to utilize the advanced approaches of processing the signals and various aspects of discrete system design.

5. Course Plan: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	Review of the fundamental concepts of digital signal processing, DFT and FFT	
	Unit 2	Structures for realization of FIR and IIR systems and their analysis.	
Component 2	Unit 3	Design of FIR filters, Introduction of Multirate Signal processing	
	Unit 4	Introduction to Statistical signal processing	

6. Text Book/ References

1. J G Proakis, Digital Signal Processing, 3rd edition PHI, 2010

Digital Signal Processors

1. Name of the Course: Introduction to Digital Signal Processors
2. LTP structure of the course: 2:1:1
3. Objective of the course: Digital signal processors are used in numerous applications such as video compression, wireless communication, multimedia etc. This course is intended to be the text for a first course in digital signal processors so that students can understand the methodology needed to design and implementation for these applications. Although many topics are covered in each of these parts, the syllabus is more than just a survey of the basics of subject.
4. Outcome of the course: To provide an overall picture and working principles of Digital Signal Processors. The students will understand the principles of programmable DSP, Architecture of TMS320C55X/2000, Assembly level Language, Overview of Motorola DSP563XX and Introduction FPGA based DSP system design.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction to digital signal processor, Digital Signal Processor Architecture, Software development, Hardware Issue	
	Unit 2	Fixed point Digital Signal Processor, TMS320C55X /2000 , Experiment and Problems	
Component 2	Unit 3	Design and implementation of FIR and IIR filters. Assembly language Instructions	
	Unit 4	Recent trends in DSP system design	

6. Text Book:

1. Digital Signal Processors: Architecture, Programming and Applications, By B. Venkataramani, M. Bhaskar TMH publications.
2. Digital Signal Processors: Architectures, Implementations, And Applications, By Kuo, Pearson Education

7. References:

1. Emmanuel Ifeacher, Jervis B.W, “Digital Signal Processing: A Practical Approach”, Pearson Education, 2002 4.
2. TI DSP Processor User Manuals

1. Name of the Course: Codec Design

2. LTP structure of the course: 2:1:1

3. Objective of the course: This course aims to fill a gap in the market between theoretical and Over-simplified texts on video coding. It focuses primarily on design And implementation perspective. A grasp of the design techniques, Trade-offs and performance issues are important to anyone who needs to design, specify or interface to video CODECs.

4. Outcome of the course: This course emphasizes the practical considerations rather than rigorous mathematical theory and concentrates on the current generation of video coding systems, embodied by the MPEG-2, MPEG-4 and H.263 standards.

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Digital video, Image and video compression fundamentals, Motion estimation and compensation	
	Unit 2	Video coding standards: JPEG and MPEG, Video coding standards: H.261, H.263 and H.26L	
Component 2	Unit 3	Transform coding, Entropy coding, Pre and Post processing; Rate, Distortion and Complexity	
	Unit 4	Transmission of Coded Video, Platforms, Video CODEC Design	

6. Text Book:-

2. Video Codec Design: Developing Image and Video Compression Systems, Iain E. G. Richardson, John Wiley & Sons Ltd.

7. References:-

1. Design and Implementation – practical Flex TM Paging Decoder- by Wayne Toth (Author)

ADD-ON Specialization on Advanced Embedded System
(For B. Tech., ECE Students)

Advance Embedded System

1. **Name of the Course: Advance Embedded System**
2. **LTP structure of the course**: 2:1:1
3. **Objective of the course:** To let the B. Tech. (ECE) students exposed to study Advance Embedded System and to demonstrate their application on physical systems and technical devices.
4. **Outcome of the course**: Students will be able to solve industry standard problems in embedded system

5. **Course Plan:** As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	**INTRODUCTION AND REVIEW OF EMBEDDED HARDWARE:** Terminology, Timing diagram, Memory, Microprocessor buses, DMA, Interrupts, Robin, Architecture algorithm.	
	2	**REAL TIME OPERATING SYSTEM** Task, Message queues, timing functions, Events, Memory management, Interrupt routines, Design using RTOS.	
Component-2	3	**EMBEDDED HARDWARE, SOFTWARE AND PERIPHERA** Sequence, processor design, Architecture operation, ASIP, timers, counters ,UART, LCD, modulator,controller	
	4	**MEMORY, INTERFACING AND PROCESS MODEL** Memory write ability, storage , types, I/O addressing, Interrupts, protocol, FSM, HCFSL, Concurrent model.	

Text /Reference books

1. David. E.Simon, “An Embedded Software Primer”, Pearson Education, 2001.
2. Frank Vahid and Tony Gwargie, “Embedded System Design”, John Wiley & sons, 2002.
3. Steve Heath, “Embedded System Design”, Elsevier, Second Edition, 2004.

FPGA based system design

1. Name of the Course: FPGA based system design
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the B. Tech. (ECE) students exposed to learn about FPGA based system Design and to demonstrate their application on physical systems and Technical devices.

4. Outcome of the course: Students will be able to solve industry standard problems in FPGA Design

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	**INTRODUCTION: ASICS, CMOS LOGIC AND ASIC LIBRARY** Design Flow, CMOS design rules, logic cell, Data path, Transistors as Resistors, Capacitance, Architecture.	
	2	**INTERCONNECTS AND ASIC DESIGN SOFTWARE** Xilinx LCA & EPLD, Altera MAX &FLEX, Design systems, Logic Synthesis, Design language, PLA tools,EDIF.	
Component-2	3	**LOGIC SYNTHESIS, SIMULATION AND TESTING** Verilog, VHDL, logic synthesis, Types of simulation, BST, Fault Simulation. ATPG, Built-in self test.	
	4	**FLOOR PLANNING, PLACEMENT AND ROUTING** FPGA partitioning, floor planning, placement, physical design flow, global routing,circuitextraction – DRC.	

Reference books

1. M.J.S. SMITH, “Application Specific Integrated Circuits”, Addison Wesley Longman Inc., 1997.
2. Wolf Wayne, “FPGA Based System Design”, Pearson Education India, 2004.
3. Design manuals of Altera, Xilinx and Actel. (From the web).

RTOS

1. Name of the Course: RTOS
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let B. Tech. (ECE) students exposed about RTOS and to demonstrate their application on physical systems and technical devices.
4. Outcome of the course: Students will be able to solve industry standard problems in RTOS

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	**REVIEW OF OPERATING SYSTEMS** Basic Principles, System Calls, Files, Design and Implementation of processes, OS Structures.	
	2	**DISTRIBUTED OPERATING SYSTEMS** Topology, Network types, Communication, RPC, Client server model, Distributed file system, Design strategies.	
Component-2	3	**REAL TIME MODELS AND LANGUAGES** Event, Process, Graph, Petrinet, Tasks, scheduling, Interrupt processing, Synchronization, Control Blocks.	
	4	**REAL TIME KERNEL AND RTOS APPLICATION DOMAINS** Principles, Design issues, Polled Loop Systems, Porting, Application- Image processing, fault tolerant, IP, control.	

Reference books

1. Charles Crowley, "Operating Systems-A Design Oriented approach", McGraw Hill 1997.

2. Tanenbaum, "Distributed Operating Systems", Pearson Education.

3. Raymond J.A.Bhur, Donald L.Bailey, "An Introduction to Real Time Systems", PHI 1999

Embedded System for Wireless Communication

1. Name of the Course: Embedded System for Wireless Communication

2. LTP structure of the course: 2:1:1

3. Objective of the course: To let the B. Tech. (ECE) students exposed about Embedded System for Wireless Communication and to demonstrate their application on physical systems and technical devices.

4. Outcome of the course: Students will be able to solve industry standard problems in Embedded System for Wireless Communication

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	**INTRODUCTION TO WIRELESS TECHNOLOGIES** WAP services, Serial and Parallel, Asynchronous and synchronous, FDM,TDM, TFM, Spread spectrum.	
	2	**BLUETOOTH RADIO AND BLUETOOTH NETWORKING** Core protocols, Antenna Parameters, Frequency hoping,Adhoc network, Bluetooth security, GAP, SDA.	
Component-2	3	**SECONDARY BLUETOOTH PROFILE HARDWARE** packet format, Transmission buffers, Link Manager Protocol, Host control Interface, Protocol Interaction.	
	4	**BLUETOOTH SERVICES REGISTRATION &APPLICATION** Bluetooth client and server application, Overview of IrDA, HomeRF, Wireless LANs, JINI.	

Reference Books:

1. C.S.R. Prabhu and A.P. Reddi,“ Bluetooth Technology”, PHI Publication.
2. U. Dalal& M. Shukla, "Wireless & Mobile Communication", Oxford University Press.
3. C. Y. William, Lee, "Mobile communication engineering theory and applications", TMH, Publication.
4. S .Haykins, “Communication Systems”, John Wiley and Sons.

Embedded System Testing

1.Name of the Course: Embedded System Testing
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the first year B. Tech. (ECE) students exposed about Embedded System Testingand to demonstrate their application on physical systems and technical devices.
4. Outcome of the course: Students will be able to solve industry standard problems in embedded system

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	Unit 1	**FUNDAMENTALS OF EMBEDDED SOFTWARE TESTING**Introduction, TEmb method, Test cases and test procedures,multiple V-model, master test planning.	
	Unit 2	**TESTING METHODS** Dynamic Testing, Model-Based Testing,Coverage Testing, Coverage measures, Coverage testing tools.	
Component-2	Unit 3	**STATIC ANALYSIS AND CODE REVIEWS** Code Reviews,Static analysis concepts and tools, coding standards, Need for metrics, Metrics for test.	
	Unit 4	**SOFTWARE INTEGRATION** Top-down Vs Bottom-up Integration, Integration models Testing from Use Cases, Regression Testing.	

6. Text Book:

1. An Embedded Software Primer, by David E. Simon.
2. Programming Embedded System, by Michael Barr.

7. References:

1. Testing Embedded Software by Bart Broekman, Edwin Notenboom.
2. The Art of Software Testing, Second Edition, Glenford J. Myers.

Control of Embedded System

1.Name of the Course: Control of Embedded System
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the first year B. Tech. (ECE) students exposed about Control of Embedded System and to demonstrate their application on physical systems and technical devices.
4. Outcome of the course: Students will be able to solve industry standard problems in control of embedded system

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	Unit 1	**INTRODUCTION** Data lines, Address lines, Ports, Bit masking, Programmable peripheral interface – 74 LS 244.	
	Unit 2	**INPUT-OUTPUT DEVICES** Keyboard scanning algorithm, Multiplexed LED displays, LCD modules, Timer manager, IRQ**,** ISR, Interrupt vector.	
Component-2	Unit 3	**D/A AND A/D CONVERSION** R- 2R ladder, Resistor network analysis, Port offsets, Auto port detect, multiple channelA/D acquisition.	
	Unit 4	**ASYNCHRONOUS SERIAL COMMUNICATION** RS-232, RS-485, Sending and receiving data, Serial ports on PC-low level, PC serial I/O, Buffered serial I/O.	

REFERENCE BOOKS

1. Jean J. Labrosse, “Embedded Systems Building Blocks: Complete and Ready To Use Modules in **C**”, CMP
Books 2000.
2. Ball S.R., “Embedded microprocessor Systems – Real World Design”, Prentice Hall, 1996.
3. Herma K, “Real Time Systems – Design for distributed Embedded Applications”, Kluwer Academic, 1997.
4. Daniel W. Lewis, “Fundamentals of Embedded Software where C and Assembly meet”, PHI, 2002.

ADD-ON Minor on Embedded System
(For B. Tech., IT Students)

Digital IC Design (core)

1. Name of the Course: IC Design
2. LTP structure of the course: 2:1:1
3. Objective of the course: To make students familiar with fundamentals of digital IC/system design using MOS/CMOS digital logics and circuits. Students also would be benefited by the Lab experiments
4. Outcome of the course: Students will be able to solve industry standard problems in digital system design.
5. Course Plan: Students will be able to solve industry standard problems in Digital IC core.

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Introduction:** VLSI Design Flow, Design Hierarchy, Scaling and Small-Geometry effects, MOS Inverters	Chapter 1-3, S. Kang
	Unit 2	**Static and Dynamic MOS circuits**: CMOS Inverters, Logic gate design, elmore delay	Chapter 5-6, S. Kang
Component 2	Unit 3	**Combinational and Sequential Circuits**, Switching Characteristics, Timing Circuits, Clocks, state machines	Chapter 7-8, S. Kang
	Unit 4	**Memory:** NAND-NOR Flash Memory, SRAM DRAM.	Chapter 9-10, S. Kang

6. Text Book:
M.JanRabaey, A. P. Chandrakasan, and B.Nikolic.Digital integrated circuits.Vol. 2. Englewood Cliffs: Prentice hall, 2002.
Sung-MoKang, and Y Leblebici. CMOS digital integrated circuits.Tata McGraw-Hill Education, 2003.

7. References:
D.A. Pucknell, and K Eshraghian, Basic VLSI Design, 3rd Ed.,Prentice-Hall of India.
N H.E.Weste, D Harris, CMOS VLSI Design-A Circuits and Systems Perspective. 3rd Edition, Pearson Education, International Edition.

Verilog Programming (core)

1. Name of the Course: Verilog Programming
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the B. Tech. (ECE) students exposed about Verilog Programming and to demonstrate their application on technical devices.
4. Outcome of the course: By the end of this course, students should be able to:

- Describe Verilog hardware description, languages (HDL).
- Design digital circuits.
- Write Behavioural models of digital circuits.
- Write Register Transfer Level (RTL) models of Digital Circuits.
- Verify Behavioural and RTL models.
- Describe standard cell libraries and FPGAs
- Synthesize RTL models to standard cell libraries and FPGAs
- Implement RTL models on FPGAs and Testin and Verification

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	**IntroductiontoVerilLog HDL:** Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, **Language Constructs and Conventions**	
	2	**Gate Level Modeling:** Introduction, AND Gate Primitive, ModuleStructure, Other Gate Primitives, **Modeling at Dataflow Level** Introduction, Continuous Assignment Structure	
Component-2	3	**Behavioural Modeling:** Introduction, Operations and Assignments,FunctionalBifuracation, 'Intial' Construct, Assignments with Delays, 'Wait'Construct, MultipleAlwaysBlock	
	4	**Switch LevelModeling:** BasicTransistor Switches, CMOS Switches, BiDirectionalGates,**System Tasks, Functions and Compiler Directives:** Parameters, Path Delays, Module Parameters.	

Text books:

1. T.R. Padmanabhan, B Bala Tripura Sundari, Design Through Verilog HDL, Wiley 2009.
2. ZainalabdienNavabi, Verliog Digital System Design,TMH, 2nd Edition.

Reference books:

1. Fundamentals ofDigital Logic with Verilog Design - Stephen Brown,ZvonkocVranesic, TMH, 2nd Edition.
2. Advanced Digital Logic Design using Verilog, State Machines & Synthesis for FPGA - Sunggu Lee, Cengage Learning, 2012.
3. Verilog HDL - Samir Palnitkar, 2nd Edition, Pearson Education, 2009.
4. Advanced Digital Design with Verilog HDL - Michel D. Ciletti, PHI,2009.

System on Chip SOC

1. Name of the Course: System on Chip (SOC)
2. LTP structure of the course: 2:1:1
3. Objective of the course: To make students familiar SOC also would be benefited by the Lab experiments
4. Outcome of the course: Students will be able to solve industry standard problems in SOC
5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	**SOC fundamentals** Essential issues of SoC design, A SoC for Digital still camera, multimedia IP development : Image and video codecs.	
	2	**SOC software and energy management** SoC embedded software, energy management techniques for SoC design. **System design and methodology** Design methodology for NOC based systems, Mapping concurrent application onto architectural platforms.	
Component-2	3	**Hardware and basic infrastructure** Packet switched network for on-chip communication, energy reliability tradeoff for NoC's, clocking strategies, parallel computer as a NoC's region.	
	4	**Software and application interfaces** MP-SoC from software to hardware, NoC APIs, multilevel software validation for NoC, Software for network on chip	

REFERENCE BOOKS

1. Axel Jantsch, HannuTenhunen, "Network on chips", Kluwer Academic Publishers, 2003.
2. Youn-Long, Steve Lin, "Essential Issues of SoC Design: Designing Complex Systems-On Chip ", Springer, 2006.

Advance Embedded System

1.Name of the Course: Advance Embedded System
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the B. Tech. (ECE) students exposed to study Advance Embedded System and to demonstrate their application on physical systems and technical devices.
4. Outcome of the course: Students will be able to solve industry standard problems in embedded system

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	**INTRODUCTION AND REVIEW OF EMBEDDED HARDWARE:** Terminology, Timing diagram, Memory, Microprocessor buses, DMA, Interrupts, Robin, Architecture algorithm.	
	2	**REAL TIME OPERATING SYSTEM** Task, Message queues, timing functions, Events, Memory management, Interrupt routines, Design using RTOS.	
Component-2	3	**EMBEDDED HARDWARE, SOFTWARE AND PERIPHERA** Sequence, processor design, Architecture operation, ASIP, timers, counters ,UART, LCD, modulator,controller	
	4	**MEMORY, INTERFACING AND PROCESS MODEL** Memory write ability, storage , types, I/O addressing, Interrupts, protocol, FSM, HCFSL, Concurrent model.	

Reference books

1. David. E.Simon, “An Embedded Software Primer”, Pearson Education, 2001.
2. Frank Vahid and Tony Gwargie, “Embedded System Design”, John Wiley & sons, 2002.
3. Steve Heath, “Embedded System Design”, Elsevier, Second Edition, 2004.

Embedded System Testing

1.Name of the Course: Embedded System Testing
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the first year B. Tech. (ECE) students exposed about Embedded System Testingand to demonstrate their application on physical systems and technical devices.
4. Outcome of the course: Students will be able to solve industry standard problems in embedded system

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	Unit 1	**FUNDAMENTALS OF EMBEDDED SOFTWARE TESTING**Introduction, TEmb method, Test cases and test procedures,multiple V-model, master test planning.	
	Unit 2	**TESTING METHODS** Dynamic Testing, Model-Based Testing,Coverage Testing, Coverage measures, Coverage testing tools.	
Component-2	Unit 3	**STATIC ANALYSIS AND CODE REVIEWS** Code Reviews,Static analysis concepts and tools, coding standards, Need for metrics, Metrics for test.	
	Unit 4	**SOFTWARE INTEGRATION** Top-down Vs Bottom-up Integration, Integration models Testing from Use Cases, Regression Testing.	

6. Text Book:

3. An Embedded Software Primer, by David E. Simon.
4. Programming Embedded System, by Michael Barr.

7. References:

3. Testing Embedded Software by Bart Broekman, Edwin Notenboom.
4. The Art of Software Testing, Second Edition, Glenford J. Myers.

Testing & Verification

1. Name of the Course: Testing and Verification
2. LTP structure of the course: 2–1–1
3. Objective of the course: To make students familiar with fundamentals of Testing and Verification
4. Outcome of the course: Students will be able to solve industry standard problems in T and V.
5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Faults**: Physical FaultsDeductive, Parallel and Concurrent Fault Simulation, ATPG for Combinational Circuits	
	Unit 2	**ATPG for Sequential Circuits**: Time Frame Expansion; Controllability and Observability Scan Design; BIST.	
Component 2	Unit 3	**PLA Testing**: Cross Point Fault Model and Test Generation, Memory Testing: Pattern Sensitive Faults; Marching Tests.	
	Unit 4	**Verification**: Design verification techniques based on simulation, analytical and formal approaches, Functional verification, Timing verification, Formal verification, Basics of equivalence checking.	

6. Text Book:

M Bushnell, and V D Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Kluwer Academic (2000).

M Abramovici, M A Breuer, and A D Friedman, Digital Systems Testing and Testable Design, Jaico Publishing House (2001)

VLSI Test Principles and Architectures: Design for Testability. Edited by Laung-Terng Wang, Cheng-Wen Wu, and Xiaoqing Wen (2006)

T Kropf, Introduction to Formal Hardware Verification, Springer Verlag (1999)

7. References: As prescribed by Faculty

Hardware Design Methodology

1. Name of the Course: Hardware Design Methodology
2. LTP structure of the course: 2–1–1
3. Objective of the course: To make students familiar with fundamentals of Hardware Design and Methodology.
4. Outcome of the course: Students will be able to solve industry standard problems in power electronics.
5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Various abstraction levels for hardware design, Introduction to commercial technology design kits, EDA tools, RTL-GDSII	
	Unit 2	Design Methods: Design techniques for analog integrated circuits and systems, Design techniques, Integration issues,	
Component 2	Unit 3	Techniques to improve performance; Analysis and Optimization: Speed, Power and Area; Low power design	
	Unit 4	Frontend, Backend Design: RTL and GATE level modeling for digital systems, Logic design and synthesis, Placement.	

6. Text Book:
N. Zainalabedin. Verilog digital system design.McGraw-Hill, 1999.
K Martin and D Johns, Analog Integrated Circuit Design, April 2012.
W. Wayne. FPGA-based systemdesign.Pearson education, 2004

Control of Embedded System

1.Name of the Course: Control of Embedded System
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the first year B. Tech. (ECE) students exposed about Control of Embedded System and to demonstrate their application on physical systems and technical devices.
4. Outcome of the course: Students will be able to solve industry standard problems in control of embedded system

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	Unit 1	**INTRODUCTION** Data lines, Address lines, Ports, Bit masking, Programmable peripheral interface – 74 LS 244.	
	Unit 2	**INPUT-OUTPUT DEVICES** Keyboard scanning algorithm, Multiplexed LED displays, LCD modules, Timer manager, IRQ**,** ISR, Interrupt vector.	
Component-2	Unit 3	**D/A AND A/D CONVERSION** R- 2R ladder, Resistor network analysis, Port offsets, Auto port detect, multiple channelA/D acquisition.	
	Unit 4	**ASYNCHRONOUS SERIAL COMMUNICATION** RS-232, RS-485, Sending and receiving data, Serial ports on PC-low level, PC serial I/O, Buffered serial I/O.	

REFERENCE BOOKS

1. Jean J. Labrosse, “Embedded Systems Building Blocks: Complete and Ready To Use Modules in **C**”, CMP
Books 2000.
2. Ball S.R., “Embedded microprocessor Systems – Real World Design”, Prentice Hall, 1996.
3. Herma K, “Real Time Systems – Design for distributed Embedded Applications”, Kluwer Academic, 1997.
4. Daniel W. Lewis, “Fundamentals of Embedded Software where C and Assembly meet”, PHI, 2002.

ADD-ON Specialization on Advanced VLSI Design
(For B. Tech., ECE Students)

FPGA Architecture& Application

1.Name of the Course: FPGA Archetecture& Application
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the B. Tech. (ECE) students exposed about FPGA Archetecture& Application and to demonstrate their application on physical systems and technical devices.
4. Outcome of the course: Students will be able to solve industry standard problems in FPGA

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	Programmable Logic ROM, PLA, PAL, PLD, programming and applications, Lattice PLST's Architectures–3000 Series–Speed Performance.	
	2	FPGAs–Logic blocks, routing architecture, Design flow, Technology Mapping for FPGAs.	
Component-2	3	Finite State Machines (FSM)-I Top-down Design–State Transition Table. Derivations of state machine charges.	
	4	FSM Architectures and Systems Level Design Architectures. System level design controller, data path and functional partition.	

6. Text Book:
1. P.K.Chan& S. Mourad, Digital Design using Field ProgrammableGate Array, Prentice Hall. 2. S.Trimberger, Edr., Field Programmable Gate Array Technology,Kluwer Academic Pub. 3. J. Old Field, R.Dorf, Field Programmable Gate Arrays, John Wiley& Sons, Newyork. 4. S.Brown,R.Francis, J.Rose, Z.Vransic, Field Programmable GateArray,Kluwer Pub. 5. Richard FJinder , "Engineering Digital Design,"Academic press

EDA

1. Name of the Course: EDA
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the B. Tech. (ECE) students exposed about EDA Tools and to demonstrate their application on technical devices.
4. Outcome of the course: **1.**An ability to apply knowledge of computer, science, and engineering to the analysis of electrical and electronic engineering problems, **2.** An ability to design systems which include hardware and software components, **3.** An ability to identify, formulate and solve engineering problems, **4.** An ability to use modern engineering techniques.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	Introduction to SPICE	
	2	Introduction to MATLAB	
Component-2	3	Introduction to HDL	
	4	Problems and solutions for spice and verilog based circuits and systems	

Text books:

1. Operation and modeling of MOS transistor, by Y. Tsividis.

2. Introduction to MATLAB, manual by MATLAB.

3. Verilog hardware description language by samir palnitkar.

Solid State Devices

1.Name of the Course: Solid State Devices
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the B. Tech. (ECE) students exposed about Solid State Devices and to demonstrate their application on technical devices.
4. Outcome of the course: **1**.Understand and explain the fundamental principles of modern semiconductor devices, **2.** Understand and describe the impact of solid-state device capabilities and limitations on electronic circuit performance, **3**. Develop the basic tools with which newly developed devices and other semiconductor applications can be studied.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	Crystal Properties; fundamental characteristics of metals, semiconductors and insulators	
	2	Energy Bands and Charge Carrier	
Component-2	3	Excess Carriers, Fermi levels and Quasi-Fermi levels, PN Junction and Metal-Semiconductor Junction	
	4	BJTs, MOS Basics, FET, Optoelectronic Devices and Emerging Technologies and novel devices	

6. Text Book:
Solid State Electronic Devices, Ben G. Streetman and Sanjay Banerjee, 6th Edition, Prentice Hall, 2006.
7. References: As prescribed by Faculty

VLSI Signal Processing

1.Name of the Course: VLSI Signal Processing
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the B. Tech. (ECE) students exposed about VLSI Signal Processing and to demonstrate their application on technical devices.
4. Outcome of the course: Students will be able to solve industry standard problems in VLSI

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	Introduction to DSP systems – Data flow representations - Iteration Bound – Pipelined and parallel processing	
	2	Retiming – unfolding – algorithmic strength reduction in filters and transforms.	
Component-2	3	Systolic architecture design – fast convolution – pipelined and parallel recursive and adaptive filters.	
	4	Numerical strength reduction – synchronous, wave and asynchronous pipelines, low power design – programmable digit signal processors & applications.	

6. Reference Books: R1. Keshab K. Parthi, "VLSI Digital signal processing systems, Design and Implementation", Wiley, Inter Science, 1999. R2. Mohammad Ismail, Terri Fiez, "Analog VLSI: Signal and Information Processing", McGraw Hill, 1994 R3. S.Y. Kung, H.J. White House, T. Kailath, "VLSI and Modern Signal Processing", Prentice Hall, 1985.

MEMS Technology

1. Name of the Course: MEMS
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the B. Tech. (ECE) students exposed about MEMS and to demonstrate their application on technical devices.
4. Outcome of the course: Students will be able to solve industry standard problems in MEMS.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	**Introduction to MEMS**: Introduction to MEMS. MEMS Sensors in Internet of Things (IoT), BioMedical Applications	
	2	**MEMS Materials and Their Properties**: Materials; Important properties: Young modulus, Poisson's ratio, piezoresistive coefficients, TCR, Thermal Conductivity.	
Component-2	3	**MEMS Devices:** Architecture, working, Microheaters, Accelerometers, Pressure Sensors, Micromirrors in DMD, Inkjet printer-head.	
	4	**MEMS Device Characterization**: Piezoresistance, TCR, Vibration, Resonant frequency, & importance of these measurements in studying device behavior.	

6. Text Book:
1. An Introduction to Microelectromechanical Systems Engineering; 2nd Ed - by N. Maluf, K Williams; Publisher: Artech House Inc 2. Practical MEMS - by Ville Kaajakari; Publisher: Small Gear Publishing 3. Microsystem Design - by S. Senturia; Publisher: Springer 4. Analysis and Design Principles of MEMS Devices - MinhangBao; Publisher: Elsevier Science 5. Fundamentals of Microfabrication - by M. Madou; Publisher: CRC Press; 2 edition 6. Micro Electro Mechanical System Design - by J. Allen; Publisher: CRC Press 7. Micromachined Transducers Sourcebook - by G. Kovacs; Publisher: McGraw-Hill

RF & IC Design

1.Name of the Course: RF & IC Design
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the B. Tech. (ECE) students exposed about RF & IC Design and to demonstrate their application on technical devices.
4. Outcome of the course: Students will be able to solve industry standard problems in RF & IC Design
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	CMOS and BiCMOS Technology, RF systems, Basic radio architectures, Process design kit, Passive and active components, Thermal Noise and Flicker Noise, Noise figure.	
	Unit 2	High frequency amplifiers, Low noise amplifiers, Power Amplifiers.	
Component 2	Unit 3	Up conversion and down conversion mixer design, PLL, Voltage controlled oscillator, Phase detector, charge pump, phase lock loop.	
	Unit 4	High speed OPAMP, OTA, negative feedback, active inductor, first order and second order low pass, high pass, band pass and band reject filter design.	

6. Text Book:
1. RF Microelectronics by BehzadRazavi (Publisher: Pearson)
2. The Design Of CMOS Radio-Frequency Integrated Circuits by Thomas H. Lee (Publisher: Cambridge University Press - 2006)
3. VLSI for Wireless Communication by Bosco Leung (Publisher: Prentice Hall - Electronics and VLSI Series)

ADD-ON Minor on VLSI Design
(For B. Tech., IT Students)

Verilog Programming

1. Name of the Course: Verilog Programming

2. LTP structure of the course: 2:1:1

3. Objective of the course: To let the B. Tech. (ECE) students exposed about Verilog Programming and to demonstrate their application on technical devices.

4. Outcome of the course: By the end of this course, students should be able to:

- Describe Verilo hardware description, languages (HDL).
- Design digital circuits.
- Write Behavioural models of digital circuits.
- Write Register Transfer Level (RTL) models of Digital Circuits.
- Verify Behavioural and RTL models.
- Describe standard cell libraries and FPGAs
- Synthesize RTL models to standard cell libraries and FPGAs
- Implement RTL models on FPGAs and Testin and Verification

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	**IntroductiontoVerilLog HDL:** Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, **Language Constructs and Conventions**	
	2	**Gate Level Modeling:** Introduction, AND Gate Primitive, ModuleStructure, Other Gate Primitives, **Modeling at Dataflow Level** Introduction, Continuous Assignment Structure	
Component-2	3	**Behavioural Modeling:** Introduction, Operations and Assignments,FunctionalBifuracation, 'Intial' Construct, Assignments with Delays, 'Wait'Construct, MultipleAlwaysBlock	
	4	**Switch LevelModeling:** BasicTransistor Switches, CMOS Switches, BiDirectionalGates,**System Tasks, Functions and Compiler Directives:** Parameters, Path Delays, Module Parameters.	

Text books:

3. T.R. Padmanabhan, B Bala Tripura Sundari, Design Through Verilog HDL, Wiley 2009.
4. ZainalabdienNavabi, Verliog Digital System Design,TMH, 2nd Edition.

Reference books:

5. Fundamentals ofDigital Logic with Verilog Design - Stephen Brown,ZvonkocVranesic, TMH, 2nd Edition.
6. Advanced Digital Logic Design using Verilog, State Machines & Synthesis for FPGA - Sunggu Lee, Cengage Learning, 2012.
7. Verilog HDL - Samir Palnitkar, 2nd Edition, Pearson Education, 2009.
8. Advanced Digital Design with Verilog HDL - Michel D. Ciletti, PHI,2009.

Introduction to Custom IC Design

1.Name of the Course: Introduction to Custom IC Design
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the B. Tech. (ECE) students exposed about Custom IC Design and to demonstrate their application on technical devices.
4. Outcome of the course: Students will be able to solve industry standard problems in IC Design
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
	1	History and overview. Integrated Circuit (IC) technology developments	
	2	Introduction to MOS transistors : characteristic and operation	
Component-2	3	Introduction to CMOS digital ICs such as gates and flip-flops	
	4	Introduction to CAD tools for IC design with basic layout rules (MOSIS) and Modeling, simulation , fault models and testing	

6. Text Book:
Neil Weste, David Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Addison Wesley, 2011, ISBN 978-0-321-54774-3

7. References: As prescribed by Faculty

VLSI Technology

1. Name of the Course: VLSI Technology
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the first year B. Tech. (ECE) students exposed about VLSI Technology and to demonstrate their application on technical devices.
4. Outcome of the course: Students will be able to solve industry standard problems in VLSI Technology
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	Introduction	
	2	Crystal Defects, Diffusion	
Component-2	3	Thermal Oxidation and Nitridation of Silicon	
	4	Ion Implantation, Photolithography, Interconnect, Etch	

6. Text Book:
1. James Plummer, M. Deal and P.Griffin, Silicon VLSI Technology, Prentice Hall Electronics and VLSI series, 2000.
2. Stephen Campbell, The Science and Engineering of Microelectronics, Oxford University Press, 1996.
3. SorabGhandhi, "VLSI Fabrication Principles," John Wiley and Sons, 1983.
4. S.M.Sze, VLSI Technology, McGraw-Hill, 1983.

7. References: As prescribed by Faculty

Digital IC Design (core)

1. Name of the Course: Digital IC Design

2. LTP structure of the course: 2:1:1

3. Objective of the course: To make students familiar with fundamentals of digital IC/system design using MOS/CMOS digital logics and circuits. Students also would be benefited by the Lab experiments

4. Outcome of the course: Students will be able to solve industry standard problems in digital system design.

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Introduction:** VLSI Design Flow, Design Hierarchy, Scaling and Small-Geometry effects, MOS Inverters	Chapter 1-3, S. Kang
	Unit 2	**Static and Dynamic MOS circuits**: CMOS Inverters, Logic gate design, elmore delay	Chapter 5-6, S. Kang
Component 2	Unit 3	**Combinational and Sequential Circuits**, Switching Characteristics, Timing Circuits, Clocks, state machines	Chapter 7-8, S. Kang
	Unit 4	**Memory:** NAND-NOR Flash Memory, SRAM DRAM.	Chapter 9-10, S. Kang

6. Text Book:

1. M.JanRabaey, A. P. Chandrakasan, and B.Nikolic.Digital integrated circuits.Vol. 2. Englewood Cliffs: Prentice hall, 2002.
2. Sung-MoKang, and Y Leblebici. CMOS digital integrated circuits.Tata McGraw-Hill Education, 2003.

7. References:

1. D.A. Pucknell, and K Eshraghian, Basic VLSI Design, 3rd Ed.,Prentice-Hall of India.
2. N H.E.Weste, D Harris, CMOS VLSI Design-A Circuits and Systems Perspective. 3rd Edition, Pearson Education, International Edition.

Analog IC Design (core)

1. Name of the Course: Analog IC Design (core)
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the B. Tech. (ECE) students exposed about Analog IC Design (core) and to demonstrate their application on technical devices.
4. Outcome of the course: Students will be able to solve industry standard problems in Analog IC Design (core)
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	Semiconductor device basics: Review of integrated circuit device characteristics & models.	
	2	Review of basic transistor amplifiers: CS, CG and CD amplifier, Differential amplifier, Frequency response of CS, CG and CD amplifier.	
Component-2	3	Operational Amplifiers: Multistage amplifiers, Frequency Response of amplifiers, feedback techniques, Stability of Feedback Amplifiers	
	4	Practical application: OPAMP in amplifiers and filters etc, Noise, non-linearity, mismatch, MOS vs Bipolar OPAMP	

6. Text Book:

1. Gray, Paul R., and Robert G. Meyer. Analysis and design of analog integrated circuits.John Wiley & Sons, Inc., 1990.

2. Razavi, Behzad. Design of analog CMOS integrated circuits. 2005.

Mixed Signal Design

1. **Name of the Course**: Mixed Signal IC Design

2. **LTP structure of the course**: 3-1-0

3. **Objective of the course**: To let the M. Tech. students exposed to Mixed Signal IC Design and to demonstrate its application.

4. **Outcome of the course**: The students will learn how to design Mixed Signal IC. Students will be exposed to this field and explore many areas of Mixed Signal IC Design.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Review of CMOS op-amps and Current and Voltage Sources, Current Mirrors, Voltage References	Chapter number from the text book may be given
	Unit 2	Noise in MOS Circuits, Introduction to Data Conversion Circuits	Chapter number from the text book may be given
Component 2	Unit 3	Data Conversion Circuits, Basic Requirements, Different A/D and D/A circuits, design & working	Chapter number from the text book may be given
	Unit 4	Clock Generation for Mixed Signal System ICs , PLL, SC ciruits	Chapter number from the text book may be given

6. Text Book/References:

1. Allen and Holberg - CMOS *Analog Circuit Design*

ADD-ON Specialization on Advanced Nano electronics devices and technology

(For B. Tech., ECE Students)

Advanced Lithography

1. **Name of the Course**: Advanced Lithography

2. **LTP structure of the course**: 3-1-0

3. **Objective of the course**: To let the students learn the advanced lithography techniques being used in the modern VLSI technology.

4. **Outcome of the course**: The students will be able to understand the basic and advanced lithography methods which will help them to pursue in the research and development the VLSI domain.

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Overview of nanofabrication. (3 hours) Lithographies. Thin film deposition techniques. Etching techniques. High resolution photon-based lithography. (7h) Deep UV lithography with high NA and/or low k1 factor. Extreme UV lithography, why selected as next generation lithography by industry. X-ray lithography, X-ray optics, mask, LIGA process. Electron beam lithography. (4h) Electron optics, e-beam sources, instrumentation. Electron-matter interaction, proximity effect, pattern design, alignment.	
	Unit 2	Resists and developers, resolution limits, contrast, sensitivity, etching selectivity. Nano-patterning by focused ion beam. (6h) Ion source, ion optics, instrumentation. Ion-matter interaction, focused ion beam etching and lithography. Focused ion beam induced deposition, mechanism and applications. Focused electron beam induced deposition.	
Component 2	Unit 3	Nanoimprint lithography (NIL). (4h) Thermal NIL, resist, thermoplastic properties of polymers, tools. UV-curable NIL, resist, whole wafer vs. step-and-flash imprint, tools. Alignment, mold fabrication, defects, limits. Reverse NIL, NIL using thermal-set resist, pulsed laser assistant NIL of metals. Nano-patterning by scanning probes. (4h)	

		AFM-based, local oxidation and dip-pen lithography. NSOM-based, near field optics, exposure of resist. STM-based, manipulation of atoms and exposure of resist.	
	Unit 4	Soft lithography. (1h) Micro-contact printing of chemical patterns, capabilities and resolution limits. Nano-transfer printing. Nano-patterning by self assembly. (4h) Anodized aluminum oxide, application as template for nano-wire growth. Nano-sphere lithography, fabrication of nanostructure of various shapes. Block copolymer self assembly, how to achieve long-range ordering.	

6. Text Book:

Nanofabrication: principles, capabilities and limits, by Zheng Cui

7. References:

1. Silicon VLSI Technology: Fundamentals, Practice, and Modeling by by James D. Plummer, Michael Deal, Peter D. Griffin, Pearson(2nd Edition)

Physics of nano Materials

1. Name of the Course: Physics of Nanomaterials

2. LTP structure of the course: 3:1:0

3. Objective of the course: This course of "Physics of Nanomaterials" generally introduces the fundamental concepts, principles and application of nanomaterials to the students Although many topics are covered in each of these parts, the syllabus is more than just a the basics of Nanomaterials.

4. Outcome of the course: The students will understand the Physics of Nano - dimensional materials.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Quantum mechanical concepts of low-dimensional systems. Concept related to Electronic Structure	
	Unit 2	Quantum confined systems , Electronic states in Heterostrutures,	
Component 2	Unit 3	Interacting Qunatum wells, Excitons, Bulk Nanostructured Materials -	
	Unit 4	Nano clusters and Nanoparticles, Nanotubes and Naowires	

6. Text Book/references:-

1. V.V. Mitin, V.A. Kochelap, and M.A. Stroscio, "Quantum Heterostructures: Microelectronics and Optoelectronics", Cambridge University Press, 1999.
2. C.P. Poole, Jr. and F.J. Owens, "Introduction to Nanotechnology", Wiley India. 2006.
3. T. Pradeep, "Nano: The essentials", Tata McGraw-Hill, 2007.
4. P. Harrison, "Quantum Wells, Wires, and Dots: Theoretical and Computational Physics", John Wiley,2000.
5. B.G. Streetman and S. Banerjee, "Solid State Electronic Devices", Prentice Hall of India, 2001.
6. A. Shik, "Quantum Wells: Physics and Electronics of two-dimensional systems", World Scientific, 1999.
7. G.L. Hornyak, J. Dutta, H.F. Tibbals and A.K. Rao, "Introduction to Nanoscience", CRC Press, 2008.

Fundamentals of Nanoscale Devices

1. Name of the Course: Fundamentals of Nanoscale Devices
2. **LTP structure of the course:**3–1–0
3. **Objective of the course:** To develop the fundamental concepts underlying the operation of nanoscale devices
4. **Outcome of the course:**The student is expected to apply in the concepts developed in their research activities.
5. **Course Plan:**

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Basic concepts:** Ballistic and diffusive conductance, Drude formula, angular averaging	
	Unit 2	**Energy Band model:** E-k relation, counting States, DOS number of modes, conductivity vs. Electron Density quantum capacitance	
Component 2	Unit 3	Quasi-Fermi Levels (QFL's), current from QFLs, Landauer Formulas, Boltzmann Equation	
	Unit 4	**Heat and Energy:**Seebeck Coefficient, heat current, one-level device, second law, entropy, fuel Value of Information	

6. **Text Book:**

2. S. Datta, “Lessons from Nanoelectronics: A New Perspective on Transport”, World Scientific, 2012.

7. References:

I. Research papers related to the topics.

Quantum Electronics

1. Name of the Course: Quantum Electronics
2. LTP structure of the course: 3:1:0
3. Objective of the course: This course explores the fundamentals of optical and optoelectronic phenomena and devices based on classical and quantum properties of radiation and matter culminating in lasers and applications. .
4. Outcome of the course:The students will able to understand the fundamentals of quantum properties of low dimensional devices.
5. Course Plan: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	**Unit 1**	**Brief review** of QuanttumMachanics and Electromagnetic waves; Light propagation through iso -and anisotropic media.	
	Unit 2	**Nonlinear** optical effects and Polarization, **Second order effects: Second harmonic generation,**	
Component 2	**Unit 3**	**Third order effects: Self and Cross Phase modulation, Phase Conjugation, Temporal and spatial solitons,**	
	Unit 4	**Quantization of the electromagnetic** field; Number states; Coherent and Squeezed states of light and their properties;	

6. Text Book/references:-

1. A. Yariv, Quantum Electronics, Ed. Wiley
2. D. J. Griffiths, Introduction to Quantum Mechanics (2^{nd} Edition), Ed. Pearson Prentice Hall
3. C.L. Tang, Fundamentals of quantum mechanics, for solid state electronics and optics, Ed. Cambridge University Press
4. W. Koechner, Solid.State Laser Engineering (6^{th} Edition), Ed. Springer
5. Saleh, B. E. A., and M. C. Teich. *Fundamentals of Photonics*. New York, NY: John Wiley and Sons, 1991. ISBN: 0471839655.
6. Cohen-Tannoudji, C., B. Diu, and F. Laloe. *Quantum Mechanics I*. New York, NY: John Wiley and Sons, 1992. ISBN: 0471569526
7. Svelto, O. *Principles of Lasers*. New York, NY: Springer-Verlag, 2004. ISBN: 0306457482.
8. Allen, L., and J. H. Eberly. *Optical Resonance and Two-Level Atoms*. New ed. New York, NY: Dover, 1987. ISBN: 0486655334.
9. Liu, Jia-Ming. *Photonic Devices.* Cambridge, UK: Cambridge University Press, 2005. ISBN: 0521551951.

Advanced Engineering Mathematics

1. **Name of the Course**: **Advanced Engineering Mathematics**

2. **LTP structure of the course**: 3-1-0

3. **Objective of the course**: The provide students with a comprehensive and up-to-date resource for teaching and learning engineering mathematics, that is, applied mathematics for engineers and physicists, mathematicians and computer scientists, as well as members of other disciplines.

4. **Outcome of the course**: A learning of comprehensive coverage, careful and correct mathematics, outstanding exercises, and self-contained subject matter with maximum flexibility.

5. **Course Plan:** As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Differential Equations of 1^{st}, 2^{nd} order, Power Series Solutions	
	Unit 2	Phase Plane and Nonlinear Differential Equations	
Component 2	Unit 3	Diffusion Equation, Wave Equation, Laplace Equation.	
	Unit 4	Complex variable Theory, Complex Integral Calculus, Taylor's series, Laurent Series and Residue Theorem	

6. Text Book:

1. M D Greenberg, Advanced Engineering Mathematics, Pearson Education, 2^{nd} Edition.
2. E Kreyszig, Advanced Engineering Mathematics,John Wiley & Sons, (2010)

Materials for Energy Harvesting

1. **Name of the Course**: **Materials for Energy Harvesting**

2. **LTP structure of the course**: 3-1-0

3. **Objective of the course**: With an authoritative, comprehensive and well-referenced content, it will appeal to all students, researchers and technologists interested or involved in thermoelectric devices, magnetic devices and solar energy materials science.

4. **Outcome of the course**: The aim of these is not to generate large-scale power, but to capture small amounts of energy that is 'wasted' during industrial and everyday processes.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Materials for Solar Cells, photoelectrochemical devices, defects disorder properties of TiO_2	
	Unit 2	Electro-Mechanical Energy Conversion: Polymer Electrolyte and Solid Oxide Fuel Cells, Interface mass Transport	
Component 2	Unit 3	Thermoelectricity: Introduction, Measurements, Seebeck coefficient, Thermal conductivity, Figure of Merit	
	Unit 4	Environment-friendly Nuclear Energy, Immobilization of high level radioactive waste from nuclear reactor fuel.	

6. Text Book:

1. Charles C Sorrel, Sunao Sugihara and JanuszNowotny, Materials for Energy Conversion Devices, CRC Press (2014)
2. Recent Journals.

ADD-ON Minor on Nano electronics devices and technology
(For B. Tech., IT Students)

VLSI Technology (core)

1. Name of the Course: VLSI Technology
2. LTP structure of the course: 3:1:0
3. Objective of the course: To let the first year B. Tech. (ECE) students exposed about VLSI Technology and to demonstrate their application on technical devices.
4. Outcome of the course: Students will be able to solve industry standard problems in VLSI Technology
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	Introduction	
	2	Crystal Defects, Diffusion	
Component-2	3	Thermal Oxidation and Nitridation of Silicon	
	4	Ion Implantation, Photolithography, Interconnect, Etch	

6. Text Book:

1. James Plummer, M. Deal and P.Griffin, Silicon VLSI Technology, Prentice Hall Electronics and VLSI series, 2000.
2. Stephen Campbell, The Science and Engineering of Microelectronics, Oxford University Press, 1996.
3. SorabGhandhi, "VLSI Fabrication Principles," John Wiley and Sons, 1983.
4. S.M.Sze, VLSI Technology, McGraw-Hill, 1983.

7. References: As prescribed by Faculty

MEMS Technology (core)

1. Name of the Course: MEMS
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the B. Tech. (ECE) students exposed about MEMS and to demonstrate their application on technical devices.
4. Outcome of the course: Students will be able to solve industry standard problems in MEMS.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component-1	1	**Introduction to MEMS**: Introduction to MEMS. MEMS Sensors in Internet of Things (IoT), BioMedical Applications	
	2	**MEMS Materials and Their Properties**: Materials; Important properties: Young modulus, Poisson's ratio, piezoresistive coefficients, TCR, Thermal Conductivity.	
Component-2	3	**MEMS Devices:** Architecture, working, Microheaters, Accelerometers, Pressure Sensors, Micromirrors in DMD, Inkjet printer-head.	
	4	**MEMS Device Characterization**: Piezoresistance, TCR, Vibration, Resonant frequency, & importance of these measurements in studying device behavior.	

6. Text Book:
1. An Introduction to Microelectromechanical Systems Engineering; 2nd Ed - by N. Maluf, K Williams; Publisher: Artech House Inc
2. Practical MEMS - by Ville Kaajakari; Publisher: Small Gear Publishing
3. Microsystem Design - by S. Senturia; Publisher: Springer
4. Analysis and Design Principles of MEMS Devices - MinhangBao; Publisher: Elsevier Science
5. Fundamentals of Microfabrication - by M. Madou; Publisher: CRC Press; 2 edition
6. Micro Electro Mechanical System Design - by J. Allen; Publisher: CRC Press
7. Micromachined Transducers Sourcebook - by G. Kovacs; Publisher: McGraw-Hill

Advanced Lithography

1. **Name of the Course**: Advanced Lithography

2. **LTP structure of the course**: 3-1-0

3. **Objective of the course**: To let the students learn the advanced lithography techniques being used in the modern VLSI technology.

4. **Outcome of the course**: The students will be able to understand the basic and advanced lithography methods which will help them to pursue in the research and development the VLSI domain.

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Overview of nanofabrication. (3 hours) Lithographies. Thin film deposition techniques. Etching techniques. High resolution photon-based lithography. (7h) Deep UV lithography with high NA and/or low k1 factor. Extreme UV lithography, why selected as next generation lithography by industry. X-ray lithography, X-ray optics, mask, LIGA process. Electron beam lithography. (4h) Electron optics, e-beam sources, instrumentation. Electron-matter interaction, proximity effect, pattern design, alignment.	
	Unit 2	Resists and developers, resolution limits, contrast, sensitivity, etching selectivity. Nano-patterning by focused ion beam. (6h) Ion source, ion optics, instrumentation. Ion-matter interaction, focused ion beam etching and lithography. Focused ion beam induced deposition, mechanism and applications. Focused electron beam induced deposition.	
Component 2	Unit 3	Nanoimprint lithography (NIL). (4h) Thermal NIL, resist, thermoplastic properties of polymers, tools. UV-curable NIL, resist, whole wafer vs. step-and-flash imprint, tools. Alignment, mold fabrication, defects, limits. Reverse NIL, NIL using thermal-set resist, pulsed laser assistant NIL of metals. Nano-patterning by scanning probes. (4h) AFM-based, local oxidation and dip-pen lithography. NSOM-based, near field optics, exposure of resist. STM-based, manipulation of atoms and exposure of resist.	

	Unit 4	Soft lithography. (1h) Micro-contact printing of chemical patterns, capabilities and resolution limits. Nano-transfer printing. Nano-patterning by self assembly. (4h) Anodized aluminum oxide, application as template for nano-wire growth. Nano-sphere lithography, fabrication of nanostructure of various shapes. Block copolymer self assembly, how to achieve long-range ordering.	

6. Text Book:

1. Nanofabrication: principles, capabilities and limits, by Zheng Cui

7. References:

1. Silicon VLSI Technology: Fundamentals, Practice, and Modeling by by James D. Plummer, Michael Deal, Peter D. Griffin, Pearson(2nd Edition)

Physics of nano Materials

1. Name of the Course: Physics of Nanomaterials

2. LTP structure of the course: 3:1:0

3. Objective of the course: This course of "Physics of Nanomaterials" generally introduces the fundamental concepts, principles and application of nanomaterials to the students Although many topics are covered in each of these parts, the syllabus is more than just a the basics of Nanomaterials.

4. Outcome of the course: The students will understand the Physics of Nano - dimensional materials.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Quantum mechanical concepts of low-dimensional systems. Concept related to Electronic Structure	
	Unit 2	Quantum confined systems , Electronic states in Heterostrutures,	
Component 2	Unit 3	Interacting Qunatum wells, Excitons, Bulk Nanostructured Materials -	
	Unit 4	Nano clusters and Nanoparticles, Nanotubes and Naowires	

6. Text Book/references:-

1. V.V. Mitin, V.A. Kochelap, and M.A. Stroscio, "Quantum Heterostructures: Microelectronics and Optoelectronics", Cambridge University Press, 1999.
2. C.P. Poole, Jr. and F.J. Owens, "Introduction to Nanotechnology", Wiley India. 2006.
3. T. Pradeep, "Nano: The essentials", Tata McGraw-Hill, 2007.
4. P. Harrison, "Quantum Wells, Wires, and Dots: Theoretical and Computational Physics", John Wiley,2000.
5. B.G. Streetman and S. Banerjee, "Solid State Electronic Devices", Prentice Hall of India, 2001.
6. A. Shik, "Quantum Wells: Physics and Electronics of two-dimensional systems", World Scientific, 1999.
7. G.L. Hornyak, J. Dutta, H.F. Tibbals and A.K. Rao, "Introduction to Nanoscience", CRC Press, 2008.

Fundamentals of Nanoscale Devices

1. Name of the Course: Fundamentals of Nanoscale Devices
2. **LTP structure of the course:**3–1–0
3. **Objective of the course:** To develop the fundamental concepts underlying the operation of nanoscale devices
4. **Outcome of the course:**The student is expected to apply in the concepts developed in their research activities.
5. **Course Plan:**

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Basic concepts:** Ballistic and diffusive conductance, Drude formula, angular averaging	
	Unit 2	**Energy Band model:** E-k relation, counting States, DOS number of modes, conductivity vs. Electron Density quantum capacitance	
Component 2	Unit 3	Quasi-Fermi Levels (QFL's), current from QFLs, Landauer Formulas, Boltzmann Equation	
	Unit 4	**Heat and Energy:**Seebeck Coefficient, heat current, one-level device, second law, entropy, fuel Value of Information	

6. **Text Book:**

1. S. Datta, “Lessons from Nanoelectronics: A New Perspective on Transport”, World Scientific, 2012.

7. References:

I. Research papers related to the topics.

Materials for Energy Harvesting

1. **Name of the Course**: **Materials for Energy Harvesting**

2. **LTP structure of the course**: 3-1-0

3. **Objective of the course**: With an authoritative, comprehensive and well-referenced content, it will appeal to all students, researchers and technologists interested or involved in thermoelectric devices, magnetic devices and solar energy materials science.

4. **Outcome of the course**: The aim of these is not to generate large-scale power, but to capture small amounts of energy that is 'wasted' during industrial and everyday processes.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Materials for Solar Cells, photoelectrochemical devices, defects disorder properties of TiO_2	
	Unit 2	Electro-Mechanical Energy Conversion: Polymer Electrolyte and Solid Oxide Fuel Cells, Interface mass Transport	
Component 2	Unit 3	Thermoelectricity: Introduction, Measurements, Seebeck coefficient, Thermal conductivity, Figure of Merit	
	Unit 4	Environment-friendly Nuclear Energy, Immobilization of high level radioactive waste from nuclear reactor fuel.	

6. Text Book:

1. Charles C Sorrel, Sunao Sugihara and JanuszNowotny*,* Materials for Energy Conversion Devices, CRC Press (2014)
2. Recent Journals.

ADD-ON Specialization on Advanced Instrumentation and Control
(For B. Tech., ECE Students)

Modern Control Systems

1. Name of the Course: Modern Control Systems

2. LTP structure of the course: 3-1-0

3. Objective of the course: To introduce the nature of nonlinearities found in control systems both in the forward path and in the feedback path.

4. Outcome of the course: Ability to apply knowledge of advanced principles to the analysis of electrical and computer engineering problems, design of electrical and computer engineering systems.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction to Linear Systems, Vector spaces, Linear systems, similarity transformations,	
	Unit 2	Canonical forms, Controllability, Observability, Realisability etc. Minimal realization, State-space realizations Root locus concepts, State Feedback	
Component 2	Unit 3	Deadbeat response-pole assignment with state and with output feedback.	
	Unit 4	Quadratic Regulator (LQR), Linear Quadratic Gaussian (LQG) control, Loop Transfer Recovery (LTR).	

Primary References Books:

1. Ogata, K., Modern Control Engineering, Prentice-Hall, [2002]

2. Hsu, J. C. & A. U. Meyer, Modern Control Principles and Applications, McGraw-Hill, [1968]

3. P.R. Belanger, *Control Engineering – A Modern Approach*, Oxford University Press, 1995.

Secondary References:

1. Gopal, M., Modern Control System Theory, John Wiley Eastern Ltd. New Delhi, [1984]

2. Friedland, B., Control System Design, McGraw-Hill, [1986]

Non-Conventional energy Sources

1. Name of the Course: **NONCONVENTIONAL ENERGY RESOURCES**

2. LTP structure of the course: 3-1-0

3. Objective of the course: The purpose of this course to introduce the students about the latest developments in the field of nonconventional energy resources.

4. Outcome of the course: This course will encourage the students to apply their ideas in the field of nonconventional energy resources.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Various nonconventional energy resources-introduction, Availability, classification, relative merits and demerits.Solar cells:Theory of solar cells, solar cell materials, solar cell array , solar cell power plant and limitatuons.	Chapter number from the text book may be given
	Unit 2	Solar thermal energy:Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.	Chapter number from the text book may be given
Component 2	Unit 3	Geothermal energy:Resources of geothermal energy, thermodynamics of geothermal energy conversion- electrical conversion , non electrical conversion, environmental considerations. Magneto hydro dynamics (MHD):Principle of working of MHD power plant , performance and limitations. Fuel cells :Principle of working of various types of fuel cells and their working, performance and limitations.	Chapter number from the text book may be given
	Unit 4	Thermoelectric and Thermoionic conversions: Principle of working, performance and limitations. Wind Energy:Wind power and it's sources , site selection, criterion, momentum theory , classification of rotors, concentrations and augments , wind characteristics. Performance	Chapter number from the text book may be given

		and limitations of energy conversion systems. Availability of Biomass and it's conversion theory. Ocean Thermal Energy conversion:Availability, theory and working principle , performance and limitations. Wave and Tidal wave:Principle of working , performance and limitations , waste recycling plants.	

5. Text Book/References :-

1. N.K. Bansal, "Non-Conventional Energy Resources", Vikas Publishing House , 2016
2. B H Khan, "Non-Conventional Energy Resources", Tata McGraw-Hill Education, 2006

Sensors and Sensor Networks

1. Name of the Course: **Sensors and Sensors Networks**

2. **LTP structure of the course**: 3-1-0

3. Objective of the course: The purpose of this course to introduce the students about the latest developments in the field of Sensors and Sensors Networks.

4. Outcome of the course: This course will encourage the students to apply their ideas in the field Sensors and Sensors Networks.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Introduction:** Features, Design challenges, Network architecture, Applications, Sensor deployment mechanism, Topologies and characteristics.	Chapter number from the text book may be given
	Unit 2	**Network and Component Technologies:** Sensors, Coverage, Physical layer, Sensor platforms, Reliable data transport, Radio energy consumption model, Power management, Synchronization, Localization.	Chapter number from the text book may be given
Component 2	Unit 3	**Data Transmission and Routing:** Data processing and aggregation, Data storage, Node discovery algorithms, Wireless sensor network routing, Proactive and reactive routing.	Chapter number from the text book may be given
	Unit 4	**Protocols:** Frame structure, Network clustering protocols, Medium access control protocols, Multi-hop communication protocols, Congestion control and rate control protocols, Protocol overheads.	Chapter number from the text book may be given

6. Text Book/References:-

1. A.K. Sawhney, "A Course in Electronic Measurements and Instrumentation" Dhanpat Rai & Co. (P) Limited, (2015)
2. Ernest O. Doebelin, "Measurement Systems: Application and Design", McGraw-Hill, 2004

Advanced Medical Instrumentation

1. Name of the Course: **Advanced Medical Instrumentation**

2. LTP structure of the course: 3-1-0

3. Objective of the course: The purpose of this course to introduce the students about the latest developments in the field of Medical Instrumentation.

4. Outcome of the course: This course will encourage the students to apply their ideas in the field of Medical Instrumentation.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Introduction of Bio-medical Instrumentation, Sources of Bioelectric Potentials and Electrodes**	Chapter number from the text book may be given
	Unit 2	**Cardiovascular System and Measurements:** The heart and cardiovascular system, ECG, blood pressure and its Measurement, respiration and pulse rate, characteristics and measurement of blood flow meter.	Chapter number from the text book may be given
Component 2	Unit 3	**Respiratory and Neuro-muscular System:** The physiology of the respiratory system, test and instrument for the mechanics of breathing.	Chapter number from the text book may be given
	Unit 4	**Measurement and Recording of Noninvasive Diagnostic Instrumentation, Patient Care and Electrical Safety:**Principle of ultrasonic measurement, ultrasonic, thermography, elements of intensive care monitoring, X-ray, CT – Scan and MRI.	Chapter number from the text book may be given

6. Text Book/References:

1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements "Prentice Hall India Learning Private Limited, 1990
2. Carlos De Morais Cordeiro, Dharma P. Agrawal, "Ad Hoc & Sensor Networks: Theory And Applications", World Scientific Pub Co Inc, 2006

Robust Control Systems

1. Name of the Course: Robust Control Systems

2. LTP structure of the course: 3-1-0

3. Objective of the course: To expose students to different real time robust control system they see in their daily life. How they can build any of these. What are the basic principles involved in this.

4. Outcome of the course: Acquire and apply the knowledge of domain engineering for system modeling, analysis and problem solving. Design control for various systems. Use simulation software and tools for analysis and implementing controller.

5. Course Plan: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	Linear Quadratic Regulators: return ratio & difference, sensitivity function.	
	Unit 2	Kalman's optimality condition. Gain/phase margins, robustness to time delay and nonlinearity.	
Component 2	Unit 3	Characterization of sensitivity. Kharitonov theorem robustness.	
	Unit 4	Singular values - properties, application in stability, robustness and sensitivity. Robustness of discrete time LQR systems.	

6. Text Books/References:

1. Kemin Zhou," ESSENTIALS OF ROBUST CONTROL", Pearson,1997.
2. *Sigurd Skogestad* and *Ian Postlethwaite, " MULTIVARIABLE FEEDBACK CONTROL: Analysis and design"* Wiley-Interscience; 2 edition (November 4, 2005)
3. *Kemin Zhou, John C. Doyle, Keith Glover, "Robust and Optimal Control 1st Edition"*Pearson; 1 edition (August 17, 1995)

Intelligent Control Systems

1. Name of the Course: Intelligent Control Systems

2. LTP structure of the course: 3-1-0

3. Objective of the course: To expose students to different real time intelligent system they see in their daily life. How they can build any of these. What are the basic principles involved in this.

4. Outcome of the course: Acquire and apply the knowledge of domain engineering for system modeling, analysis and problem solving. Design control for various systems. Use simulation software and tools for analysis and implementing controller.

5. Course Plan: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**

Component 1	Unit 1	Intelligent systems, control and intelligent systems Fuzzy and expert control, planning systems, attentional systems,	
	Unit 2	Learning and function approximation, adaptive control introduction, learning/adaptation,	
Component 2	Unit 3	stable fuzzy/neural adaptivecontrol, Evolutionary methods, foraging, bacteria and connections to optimization and control,	
	Unit 4	coordinated vehicular guidance applications, motor control application, inverted pendulum application.	

Primary References Books:

1. K. Passino, "Biomimicry for Optimization, Controland Automation", springer verlag,2005.

2. Kevin M. Passino and Stephen Yurkovich, "Fuzzy Control", Addison Wesley Longman, Menlo park,CA 1998.

3. Antsaklis P.J., Passino K.M. ,"An Introduction to Intelligent and Autonomous Control", Kluwer Piblishers Norwell MA 1993.

4. Timothi J. Ross, "Fuzzy logic with engineering applications", Wiley, 1995.

Embedded Control System

1. Name of the Course: Embedded Control Systems

2. LTP structure of the course: 3-1-0

3. Objective of the course: To expose students to different real time embedded system they see in their daily life. How they can build any of these. What are the basic principles involved in this.

4. Outcome of the course: Acquire and apply the knowledge of domain engineering for system modelling, analysis and problem solving. Design control for various systems. Use simulation software and embedded tools for analysis and implementing controller.

5. Course Plan: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	CONTROL SYSTEM BASICS: Z-transforms – performance requirements - block diagrams	
	Unit 2	CONTROL SYSTEM IMPLEMENTATION: CONTROL SYSTEM TESTING:	

Component 2	Unit 3	INPUT DEVICES:KEYBOARD, LCD MODULES, Timer Interrupts, multiple channel analog to digital dataacquisitionOUTPUT DEVICES AND SENSORS:	
	Unit 4	H-bridge, dc motor control, optical encoders, different sensors interfacing, Case study of application.	

Primary References Books:

1. Jim Ledin, "Embedded control systems in C/C++", CMP Books, 2004.
2. TimWiscott, "Applied control for embedded systems", Elsevier Publications, 2006.
3. Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C ", The publisher, Paul Temme, 2011.
4. Ball S.R., "Embedded microprocessor Systems - Real World Design", Prentice Hall, 2002.
5. Lewin A.R.W. Edwards, "Open source robotics and process control cookbook", Elsevier Publications, 2005.
6. Ben-Zion Sandler, "Robotics", Elsevier Publications, 1999

Networked Control Systems

1. Name of the Course**: Networked Control Systems**

2. LTP structure of the course: 2-1-0

3. Objective of the course: To expose students to different real time networkedcontrol system they see in their daily life. How they can build any of these. What are the basic principles involved in these.

4. Outcome of the course: At the end of the course, the student must be able to:

- Construct and analyse a discrete-time model for a dynamic system
- Analyze a multivariable dynamic system and design an appropriate controller for the system,
- Assess / Evaluate the stability, performance and robustness of a closed-loop system
- Propose several control solutions, formulate the trade-offs, choose the options

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	1	Overview of Networked Control Systems, Overview of Agent-based Control and Management for NCS, Review of linear systems and Lyapunov stability, Linear matrix inequalities and switched systems	
	2	Features of control networks, Stability and Stabilization of Networked Control Systems, Robust H ∞ Control and Filtering of Networked Control Systems	
Component 2	3	Elements of graph theory, Discrete-time consensus algorithms, Graph Laplacians, Event-Triggered Feedback in Control, Estimation, and Optimization	
	4	Continuous-time consensus algorithms, Synchronization problems, Optimal Adaptive Control of Uncertain Linear Network Control Systems	

Primary References Books:

1. Wang, Fei-Yue, Liu, Derong (Eds.), "Networked Control Systems:Theory and Applications"Springer-Verlag London 2008
2. Bemporad, Alberto, Heemels, Maurice, Vejdemo-Johansson, Mikael, "Networked Control Systems" Springer-Verlag London 2010
3. Jagannathan Sarangapani, Hao Xu, "Optimal Networked Control Systems with MATLAB" CRC press 2015

Digital Control Systems

1. Name of the Course: Digital Control Systems

2. LTP structure of the course: 3-1-0

3. Objective of the course: To expose students to different real time digital control system they see in their daily life. How they can build any of these. What are the basic principles involved in this.

4. Outcome of the course: Acquire and apply the knowledge of domain engineering for system modeling, analysis and problem solving. Design control for various systems. Use simulation software and tools for analysis and implementing controller.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Discrete-time signals and systems, Z-transform, pulse transfer functions.	
	Unit 2	Compensator design by root locus, error coefficients and frequency response.	
Component 2	Unit 3	State-space models of discrete time systems, controllability, observability, stability, state estimation,	
	Unit 4	Kalman filtering. Linear regulation. Parameter estimation.	

Text Books/References:

1. Gene F. Franklin, J. David Powell, Michael L. Workman, "Digital Control of Dynamic Systems(3rd Edition)" Addison-Wesley; 3 edition (December 29, 1997)
2. Katsuhiko Ogata (Author), "Discrete-Time Control Systems (2nd Edition) 2nd Edition" Pearson; 2 edition (January 19, 1995)

ADD-ON Minor on Instrumentation and Control
(For B. Tech., IT Students)

Electronic Measurement & Instrumentation (core)

Name of the Course: Electronics Measurement and Instrumentation
2. LTP structure of the course: 3-0-1
3. Objective of the course: To introduce them to the basics of measuring instruments. To make them aware of working and practical application of instruments. They will be exposed to sensors.
4. Outcome of the course: They will be able to understand the working principle of various instruments. That will help to make better use of measuring instruments. They will be able to use different kind of sensor. How to select a suitable measuring instrument for the any measurement. They want to build sensor for measurement they will be able to select proper material according to the need or system.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Theory Of Errors**:Accuracy& precision, Systematic & random errors Modeling of errors, Combination of errors.	
	Unit 2	**Electronic Instruments For Measuring Basic Parameters**: Electronic Voltmeters, Shielding & grounding, CTPT.	
		Oscilloscopes: Basic construction, working and use of it. Kinds of Oscilloscope.	
Component 2	Unit 3	**Signal Generation and measurement techniques**: Sine wave generators, Harmonic distortion analyzer, Spectrum analyzer.	
	Unit 4	**Transducers**Classification,Selection Criteria, Characteristics, Construction, Application of following of different transducers.	

6. Text Book:
1. A.K. Sawhney, PuneetSawhney,A Course In Electrical And Electronic Measurements And Instrumentation, DhanpatRai Publications, 2012
2. H. S. Kalsi, Electronic Instrumentation,3 edition, McGraw Hill Education, 2017

7. References: As prescribed by Faculty

Control System (core)

1. Name of the Course: Control Systems
2. LTP structure of the course: 2-1-1
3. Objective of the course: To introduce them to the basic of control systems. How a basic control system is formed. How they can analyze and build a control system.
4. Outcome of the course: Students will be able to analyze a control system if given to them. They will be able to find the equivalent mathematical model for it and if the system is not stable they will be able to, by the use techniques learned in this course, stabilize the system.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Introduction to Control Systems:** Basic Concepts of Control Systems, Feedback characteristics of Control Systems	
	Unit 2	**Time response Analysis:** Standard Test Signals. Time response of different order of systems. concept of stability.	
Component 2	Unit 3	**Frequency Response Analysis:** Frequency domain specifications, Gain and Phase Margin.	
	Unit 4	**Stability in frequency domain:** Root locus concepts, Effect of adding open loop poles and zeros, Nichol's chart, controllers.	

6. Text Book:

1. N S. Nise, Control Systems Engineering, International Student Version, 6th Edition, Wiley, April 2011.

2. R H. Bishop, Richard C. Dorf, Modern Control Systems, 12th edition, PEARSON HIGHER EDUCATION, 2010.

3. I.J. Nagrath and M Gopal, Control Systems Engineering, 6^{th} edition, New Age International Pvt Ltd, 2017

1. Name of the Course: Digital Control Systems

2. LTP structure of the course: 3-1-0

3. Objective of the course: To expose students to different real time digital control system they see in their daily life. How they can build any of these. What are the basic principles involved in this.

4. Outcome of the course: Acquire and apply the knowledge of domain engineering for system modeling, analysis and problem solving. Design control for various systems. Use simulation software and tools for analysis and implementing controller.

5. Course Plan: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	Discrete-time signals and systems, Z-transform, pulse transfer functions.	
	Unit 2	Compensator design by root locus, error coefficients and frequency response.	
Component 2	Unit 3	State-space models of discrete time systems, controllability, observability, stability, state estimation,	
	Unit 4	Kalman filtering. Linear regulation. Parameter estimation.	

Text Books/References:

1. Gene F. Franklin, J. David Powell, Michael L. Workman, "Digital Control of Dynamic Systems(3rd Edition)" Addison-Wesley; 3 edition (December 29, 1997)
2. Katsuhiko Ogata (Author), "Discrete-Time Control Systems (2nd Edition) 2nd Edition" Pearson; 2 edition (January 19, 1995)

Modern Control Systems

1. Name of the Course: Modern Control Systems

2. LTP structure of the course: 3-1-0

3. Objective of the course: To introduce the nature of nonlinearities found in control systems both in the forward path and in the feedback path.

4. Outcome of the course: Ability to apply knowledge of advanced principles to the analysis of electrical and computer engineering problems, design of electrical and computer engineering systems.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction to Linear Systems, Vector spaces, Linear systems, similarity transformations,	
	Unit 2	Canonical forms, Controllability, Observability, Realisability etc. Minimal realization, State-space realizations Root locus concepts, State Feedback	
Component 2	Unit 3	Deadbeat response-pole assignment with state and with output feedback.	
	Unit 4	Quadratic Regulator (LQR), Linear Quadratic Gaussian (LQG) control, Loop Transfer Recovery (LTR).	

Primary References Books:

1. Ogata, K., Modern Control Engineering, Prentice-Hall, [2002]

2. Hsu, J. C. & A. U. Meyer, Modern Control Principles and Applications, McGraw-Hill, [1968]

3. P.R. Belanger, *Control Engineering – A Modern Approach*, Oxford University Press, 1995.

Secondary References:

1. Gopal, M., Modern Control System Theory, John Wiley Eastern Ltd. New Delhi, [1984]

2. Friedland, B., Control System Design, McGraw-Hill, [1986]

Sensors and Sensor Networks

1. Name of the Course: **Sensors and Sensors Networks**

2. **LTP structure of the course**: 3-1-0

3. Objective of the course: The purpose of this course to introduce the students about the latest developments in the field of Sensors and Sensors Networks.

4. Outcome of the course: This course will encourage the students to apply their ideas in the field Sensors and Sensors Networks.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Introduction:** Features, Design challenges, Network architecture, Applications, Sensor deployment mechanism, Topologies and characteristics.	Chapter number from the text book may be given
	Unit 2	**Network and Component Technologies:** Sensors, Coverage, Physical layer, Sensor platforms, Reliable data transport, Radio energy consumption model, Power management, Synchronization, Localization.	Chapter number from the text book may be given
Component 2	Unit 3	**Data Transmission and Routing:** Data processing and aggregation, Data storage, Node discovery algorithms, Wireless sensor network routing, Proactive and reactive routing.	Chapter number from the text book may be given
	Unit 4	**Protocols:** Frame structure, Network clustering protocols, Medium access control protocols, Multi-hop communication protocols, Congestion control and rate control protocols, Protocol overheads.	Chapter number from the text book may be given

6. Text Book/References:-

1. A.K. Sawhney, "A Course in Electronic Measurements and Instrumentation" Dhanpat Rai & Co. (P) Limited, (2015)
2. Ernest O. Doebelin, "Measurement Systems: Application and Design", McGraw-Hill, 2004

Advanced Medical Instrumentation

1. Name of the Course: **Advanced Medical Instrumentation**

2. LTP structure of the course: 3-1-0

3. Objective of the course: The purpose of this course to introduce the students about the latest developments in the field of Medical Instrumentation.

4. Outcome of the course: This course will encourage the students to apply their ideas in the field of Medical Instrumentation.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Introduction of Bio-medical Instrumentation, Sources of Bioelectric Potentials and Electrodes**	Chapter number from the text book may be given
	Unit 2	**Cardiovascular System and Measurements:** The heart and cardiovascular system, ECG, blood pressure and its Measurement, respiration and pulse rate, characteristics and measurement of blood flow meter.	Chapter number from the text book may be given
Component 2	Unit 3	**Respiratory and Neuro-muscular System:** The physiology of the respiratory system, test and instrument for the mechanics of breathing.	Chapter number from the text book may be given
	Unit 4	**Measurement and Recording of Noninvasive Diagnostic Instrumentation, Patient Care and Electrical Safety:**Principle of ultrasonic measurement, ultrasonic, thermography, elements of intensive care monitoring, X-ray, CT – Scan and MRI.	Chapter number from the text book may be given

6. Text Book/References:-

1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements "Prentice Hall India Learning Private Limited, 1990
2. Carlos De Morais Cordeiro, Dharma P. Agrawal, "Ad Hoc & Sensor Networks: Theory And Applications", World Scientific Pub Co Inc, 2006

Embedded Control System

1. Name of the Course: Embedded Control Systems

2. LTP structure of the course: 3-1-0

3. Objective of the course: To expose students to different real time embedded system they see in their daily life. How they can build any of these. What are the basic principles involved in this.

4. Outcome of the course: Acquire and apply the knowledge of domain engineering for system modelling, analysis and problem solving. Design control for various systems. Use simulation software and embedded tools for analysis and implementing controller.

5. Course Plan: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	CONTROL SYSTEM BASICS: Z-transforms – performance requirements - block diagrams	
	Unit 2	CONTROL SYSTEM IMPLEMENTATION: CONTROL SYSTEM TESTING:	
Component 2	Unit 3	INPUT DEVICES:KEYBOARD, LCD MODULES, Timer Interrupts, multiple channel analog to digital dataacquisitionOUTPUT DEVICES AND SENSORS:	
	Unit 4	H-bridge, dc motor control, optical encoders, different sensors interfacing, Case study of application.	

Primary References Books:

1. Jim Ledin, “Embedded control systems in C/C++”, CMP Books, 2004.
2. TimWiscott, “Applied control for embedded systems”, Elsevier Publications, 2006.
3. Jean J. Labrosse, “Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C ”, The publisher, Paul Temme, 2011.
4. Ball S.R., “Embedded microprocessor Systems - Real World Design”, Prentice Hall, 2002.
5. Lewin A.R.W. Edwards, “Open source robotics and process control cookbook”, Elsevier Publications, 2005.
6. Ben-Zion Sandler, “Robotics”, Elsevier Publications, 1999

Networked Control System

Name of the Course: Networked Control Systems

2. LTP structure of the course: 2-1-0

3. Objective of the course: To expose students to different real time networkedcontrol system they see in their daily life. How they can build any of these. What are the basic principles involved in these.

4. Outcome of the course: At the end of the course, the student must be able to:

- Construct and analyse a discrete-time model for a dynamic system
- Analyze a multivariable dynamic system and design an appropriate controller for the system,
- Assess / Evaluate the stability, performance and robustness of a closed-loop system
- Propose several control solutions, formulate the trade-offs, choose the options

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	1	Overview of Networked Control Systems, Overview of Agent-based Control and Management for NCS, Review of linear systems and Lyapunov stability, Linear matrix inequalities and switched systems	
	2	Features of control networks, Stability and Stabilization of Networked Control Systems, Robust H ∞ Control and Filtering of Networked Control Systems	
Component 2	3	Elements of graph theory, Discrete-time consensus algorithms, Graph Laplacians, Event-Triggered Feedback in Control, Estimation, and Optimization	
	4	Continuous-time consensus algorithms, Synchronization problems, Optimal Adaptive Control of Uncertain Linear Network Control Systems	

Primary References Books:

4. Wang, Fei-Yue, Liu, Derong (Eds.), "Networked Control Systems:Theory and Applications"Springer-Verlag London 2008
5. Bemporad, Alberto, Heemels, Maurice, Vejdemo-Johansson, Mikael, "Networked Control Systems" Springer-Verlag London 2010
6. Jagannathan Sarangapani, Hao Xu, "Optimal Networked Control Systems with MATLAB" CRC press 2015

ADD-ON Specialization on Microwave Engineering
(For B. Tech., ECE Students)

ADD-ON Specialization on Advanced RF and Microwave Engineering

(For B.Tech. (ECE) students)

Name of the Course: Advanced Electromagnetics

2. LTP structure of the course: 3-1-0
3. Objective of the course: To let the students exposed to advanced concepts of Electromagnetism and to demonstrate their application on RF Communication.
4. Outcome of the course: The students will learn how to handle the RF Communication.
5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Review of Electromagnetics and Plane Wave Propagation:** Wave Equation, TEM Wave Propagation, Normal Incidence at plane conducting boundary.	
	Unit 2	Auxiliary Vector Potential, Construction of Solution, Radiation and Scattering Equations.	
Component 2	Unit 3	**Electromagnetic Theorems and Concepts:**Electric and magnetic current sources; Duality; Image theory; Equivalence principle; Babinet's principle; Induction theorem; Reciprocity theorem;	
	Unit 4	**Green's Functions and Plane Wave Functions:** The Wave functions, Plane Waves, The rectangular Waveguide, Partially filled waveguide.	

6. Text Book:

1. Balanis, Constantine A.**,** *Advanced Engineering Electromagnetics,*Wiley India Pvt. Ltd., Reprint 2008.
2. Cheng, D.K., *Field and Wave Electromagnetic*, 2nd Ed., Welsley Publishing Company, 1989.
3. Harrington, R.F., *Field Computation by Moment Methods*, Wiley IEEE Press. 1993.
4. Collin, R.E., *Field Theory of Guided Waves*, 2nd Ed., Wiley-IEEE Press. 1991
5. Jordan, E.C. and Balmain, K.G., *Electromagnetic Waves and Radiating Systems*. 2nd Ed., Prentice-Hall of India. 1993.

Advanced Antenna Design and Measurement

1. **Name of the Course:** Advanced Antenna Design and Measurement
2. **LTP structure of the course**: 2-1-1
3. **Objective of the course**: The objective of the course is to provide the students an in-depth knowledge of state-of-the-art antennas used in modern communication systems
4. **Outcome of the course**:The emphasis will be laid on the detailed design procedures and analysis of various antennas used in advanced communication systems.

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Revision of fundamental parameters of Antennas. Radiation from Wires and Loop.	
	Unit 2	**Aperture Antennas:**Theory of aperture antenna, including the Fourier transform method and application to slot, waveguide and horn antenna; Design consideration of parabolic reflector antenna.	
Component 2	Unit 3	**Microstrip Antennas :**Basic characteristics, feeding methods, methods of analysis, design of rectangular and circular patch antennas,Planar array, phased array and adaptive antenna; Feed network of microstrip antenna array;	
	Unit 4	**Antennas for Modern Communication Systems:**Antenna for mobile communication: handset antenna and base station antenna,MIMO antenna, Metamaterial antenna, Printed Inverted F Antenna (PIFA), Modern topics on Configurability and Filtenna.	

6. Text Book:

1. C. A Balanis, *Modern Antenna Handbook*, John Wiley & Sons, 2008.
2. C A Balanis, Antenna Theory and Design.3rd Ed., John Wiley & Sons. 2005
3. A. R. Harish, and M. Sachidananda. Antennas and wave propagation. Oxford University Press, USA, 2007.
4. C. Caloz and T. Itoh, *Electromagnetic Metamaterials: Transmission Line Theory and Microwave Applications*, John Wiley & Sons, 2006.
5. Z. N Chen and K. M. Luk, *Antennas for Base Stations*, McGraw-Hill, 2009.

References

1. Literature from various Journals relevant to specific topics.

1. Name of the Course: Microwave Circuits

2. LTP structure of the course: 3-1-0

3. Objective of the course: To let the students exposed to basic design of microwave components and their application on of RF Communication.

4. Outcome of the course: The emphasis will be laid on the detailed design procedures and analysis of various microwave circuits.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Multiple coupled Transmission lines and Microwave Filters:** coupled microstrip line, slotline, interdigital filter, microstrip line filter.	
	Unit 2	**Microwave Amplifiers:** single stage amplifier design and two stage amplifier design.	
Component 2	Unit 3	**Microwave Oscillators:** Transistor oscillator, oscillator circuit, oscillator design.	
	Unit 4	**Mixers:** Gilbert cell mixer design , linear mixer design.	

6. Text Book:

1. R. E . Collin, *Foundations for Microwave Engineering*, New York: Wiley, 2001.
2. D. M. Pozar, *Microwave Engineering*, New York: Wiley, 2006.

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1. **Name of the Course:** Tools for Microwave Measurements and Design

2. LTP structure of the course: 2-1-1

3. Objective of the course: The objective of the course is to provide the students an insight into different aspects of the advanced design and measurements techniques for RF and microwave circuits.

4. Outcome of the course:

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Challenges in microwave design. Smith chart for practical solution of microwave problems.	
	Unit 2	Transmission Line and S-Parameters. Impedance matching network design. Problem solving with s-parameters and signal flow graphs. Power, Frequency and impedance measurement at microwave frequency.	
Component 2	Unit 3	Network Analyzer and measurement of scattering parameters. Spectrum Analyzer and measurement of spectrum of a microwave signal.	
	Unit 4	Noise at microwave frequency and measurement of noise figure.	

6. Text Book:

1. Cheng, D.K., *Field and Wave Electromagnetic*, 2nd Ed., Welsley Publishing Company, 1989.
2. Bryant, G.H., P*rinciples of Microwave Measurements*, The Institution of Engineering and Technology.
3. Yip P.C.L., *High frequency circuit design and measurements,* Springer, 1990.
4. Ginzton, E.L., *Microwave Measurements.*Literary Licensing, LLC ,2012.
5. I.L. Kosow, *Microwave Theory and Measurements*, Hewlett Packard, 1st Edition, 1962.

References:

1. Technical Notes/Application Notes of various instruments and devices.

1. Name of the Course: Smart Antennas

2. LTP structure of the course: 3-1-0

3. Objective of the course: To let the students understand the concepts used in smart antennas for wireless applications.

4. Outcome of the course: Students will be able to know the architecture of smart antenna system and its need in wireless communication.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction and Fundamentals. What is a Smart Antenna, Need of smart antenna system, Overview of smart antenna system.Functions of smart antenna.	
	Unit 2	**Types of smart antenna**s: Switched beam system, Adaptive system	
Component 2	Unit 3	Fixed Weight Beam forming Basics,Maximum signal-to-interference ratio, Maximum likelihood, Minimum Variance. Adaptive Beam forming, Least mean squares, Recursive least squares, Constant modulus, Least squares constant modulus, Conjugate gradient method	
	Unit 4	The Architecture of Smart Antenna Systems.	

6. Text Book:

1. Smart Antennas, T. K. Sarkar, Michael C. Wicks, M. Salazar-Palma, Robert J. Bonneau, John Wiley & Sons, 2005.
2. Introduction to Smart Antennas, Constantine A. Balanis, Panayiotis I. Ioannides, Morgan & Claypool Publishers, 2007

References:

1. Literature from various Journals relevant to specific topics.

1. **Name of the Course: Principles of Microwave Remote Sensing for Environmental Applications**

2. LTP structure of the course: 2-1-1

3. Objective of the course: The course will provide the basics and principles of Radar Remote Sensing (specifically Synthetic Aperture Radar (SAR)) and it's imaging techniques for the use of environmental parameter estimation.

4. Outcome of the course: At the end of the course the student has the understanding of SAR imaging and Image processing techniques.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction to active and passive microwave remote sensing.	
	Unit 2	SAR basics and principles.	
Component 2	Unit 3	Scattering theory and decomposition techniques	
	Unit 4	Introduction to bio/geophysical parameter estimation (classification/segmentation, soil moisture estimation,earth quake and volcano monitoring, forest height inversion, wood biomass estimation etc.) using SAR images.	

6. Text Book:

1. Woodhouse, I. H., Introduction into Microwave Remote Sensing, CRC Press, Taylor & Francis Group, 2006.
2. Lee, J.-S., Pottier, E., Polarimetric Radar Imaging: From Basics to Applications, CRC Press, Taylor & Francis Group, 2009.
3. R. Harris, 1987. "Satellite Remote Sensing, An Introduction", Routledge & Kegan Paul.
4.

References:

1. Literature from various Journals relevant to specific topics.

1. **Name of the Course:** Modern Trends in Microwave Engineering

2. LTP structure of the course: 3-1-0

3. Objective of the course: To provide information related to the present day applications so that students and researchers desirous of working on RF related applications like RF Circuit design, RF Communication or RF propagation finds this course useful.

4. Outcome of the course: Student will be able to understand present day technologies used in Microwave, their effect on human body and applications.

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Effect of Microwaves on human body. Medical and Civil applications of microwaves. ISM band applications.	
	Unit 2	**Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC). :** Analysis of EMI, Type of Noise and Interference, Electromagnetic Compatibility, Radiated Emission and susceptibility, Benefits of good EMC Design, Brief description of EMC regulations, Examples of EMC related problems.	
Component 2	Unit 3	Monolithic Microwave IC fabrication. RF MEMS for microwave components.	
	Unit 4	Microwave Imaging: Techniques and applications.	

6. Text Book:

1. Paul, C., Introduction to Electromagnetic Compatibility, John Wiley & Sons, 1992.
2. BehzadRazavi**,** *RF Microelectronics*, Prentice Hall; 2 edition,2012.

References:

1. Technical Notes/Application Notes of various instruments and devices.
2. Journal papers as suggested by Faculty.

ADD-ON Minor on Microwave Engineering
(For B. Tech., IT Students)

Name of the Course: Electromagnetic Field and Waves

2. LTP structure of the course: 3-1-0
3. Objective of the course: To let the students exposed to basic laws of Electromagnetism and to demonstrate their application on RF Communication.
4. Outcome of the course: The students will learn how to handle the RF Communication
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Vector Analysis, Electrostatics and Magnetostatics	
	Unit 2	Time-Varying Fields and Maxwell's Equations	
Component 2	Unit 3	Uniform Plane Waves	
	Unit 4	Transmission Lines and Smith Chart	

6. Text Book:
1. Hayt, W.H. and Buck, J.A., *Engineering Electromagnetics*. 7th Ed., Tata McGraw-Hill. 2006.
2. Sadiku, M.N.O., *Elements of Electromagnetics*. 3 rd Ed., Oxford University Press.
3. Cheng, D.K., *Field and Wave Electromagnetic*, 2nd Ed., Welsley Publishing Company, 1989.

7. References:
1. Jordan, E.C. and Balmain, K.G., *Electromagnetic Waves and Radiating Systems*. 2nd Ed., Prentice-Hall of India. 1993.
2. Narayana Rao, N., *Elements of Engineering Electromagnetics*. 5th Ed., Prentice-Hall of India. 2002.
3. Shevgaonkar, R. K. *Electromagnetic waves*. Tata McGraw-Hill Education, 2005.

1. Name of the Course: Antenna and Wave Propagation

2. LTP structure of the course: 2-1-1

3. Objective of the course: To explain the theory of different types of antennas used in communication systems and different mechanisms of wave propagation in free space.

4. Outcome of the course:

By the end of the course, the students will be able to apply the concepts of antenna in its analysis, design, and measurements.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction, Antenna Parameters, Auxiliary Potential Functions	
	Unit 2	Linear Wire Antennas, Antenna arrays	
Component 2	Unit 3	Types of antennas: Travelling wave, Aperture, Reflector, Lens, Microstrip etc.	
	Unit 4	Wave Propagation with general application.	

6. Text Book:

1. Balanis, C.A., *Antenna Theory and Design*. 3rd Ed., John Wiley & Sons. 2005
2. Harish, A. R., and M. Sachidananda. *Antennas and wave propagation*. Oxford University Press, USA, 2007.

7. References:

1. Stutzman, W.L. and Thiele, H.A., *Antenna Theory and Design*. 2nd Ed., John Wiley & Sons. 1998
2. Elliot, R.S., *Antenna Theory and Design*. Revised edition, Wiley-IEEE Press. 2003
3. Collin, R.E., *Antennas and Radio Wave Propagatio*n. McGraw-Hill. 1985.
4. Shevgaonkar, R. K. *Electromagnetic waves*. Tata McGraw-Hill Education, 2005.

1. Name of the Course: Solid State Microwave Devices

2. LTP structure of the course: 2-1-1

3. Objective of the course: To provide a comprehensive introduction to various devices and passive components used at microwave frequencies.

4. Outcome of the course: By the end of the course, the student will be able to learn microwave engineering, design aspects and its applications.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction to Microwaves: Microwave Frequency bands and applications.	
	Unit 2	Rectangular waveguide and cavity.	
Component 2	Unit 3	Passive microwave devices. S parameter analysis of all components.	
	Unit 4	Microwave Tubes.Solid state Amplifiers and Oscillators.	

6. Text Book:

1. Pozar, D.M., *Microwave Engineering*. 3rd Ed., John Wiley & Sons. 2004.

2. Liao, S.Y., *Microwave Devices and Circuits*. Prentice-Hall of India. 1991.

7. References:

1. Collin, R.E., *Foundations for Microwave Engineering*. 2nd Ed., John Wiley & Sons. 2000.

2. Streetman, B.G. and Banerjee, S.K., *Solid-state Electronic Devices*. 6th Ed., Prentice-Hall of India. 2006.

3. Sze, S.M. and Ng, K.K., *Physics of Semiconductor Devices*. 3rd Ed., John Wiley & Sons. 2006.

4. Bahl, I. and Bhartia, P., *Microwave Solid State Circuit Design*. 2nd Ed., John Wiley & Sons. 2003.

1. Name of the Course: Tools for Microwave Measurements and Design

2. LTP structure of the course: 3-1-0

3. Objective of the course: The objective of the course is to provide the students an insight into different aspects of the advanced design and measurements techniques for RF and microwave circuits.

4. Outcome of the course:

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Challenges in microwave design. Smith chart for practical solution of microwave problems.	
	Unit 2	Transmission Line and S-Parameters. Impedance matching network design. Problem solving with s-parameters and signal flow graphs. Power, Frequency and impedance measurement at microwave frequency.	
Component 2	Unit 3	Network Analyzer and measurement of scattering parameters. Spectrum Analyzer and measurement of spectrum of a microwave signal.	
	Unit 4	Noise at microwave frequency and measurement of noise figure.	

6. Text Book:

1. Cheng, D.K., *Field and Wave Electromagnetic*, 2nd Ed., Welsley Publishing Company, 1989.
2. Bryant, G.H., P*rinciples of Microwave Measurements*, The Institution of Engineering and Technology.
3. Yip P.C.L., *High frequency circuit design and measurements,* Springer, 1990.
4. Ginzton, E.L., *Microwave Measurements.*Literary Licensing, LLC ,2012.
5. I.L. Kosow, *Microwave Theory and Measurements*, Hewlett Packard, 1st Edition, 1962.

References:

2. Technical Notes/Application Notes of various instruments and devices.

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1. Name of the Course: Principles of Microwave Remote Sensing for Environmental Applications

2. LTP structure of the course: 2-1-1

3. Objective of the course: The course will provide the basics and principles of Radar Remote Sensing (specifically Synthetic Aperture Radar (SAR)) and it's imaging techniques for the use of environmental parameter estimation.

4. Outcome of the course: At the end of the course the student has the understanding of SAR imaging and Image processing techniques.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction to active and passive microwave remote sensing.	
	Unit 2	SAR basics and principles.	

Component 2	Unit 3	Scattering theory and decomposition techniques	
	Unit 4	Introduction to bio/geophysical parameter estimation (classification/segmentation, soil moisture estimation,earth quake and volcano monitoring, forest height inversion, wood biomass estimation etc.) using SAR images.	

6. Text Book:

1. Woodhouse, I. H., Introduction into Microwave Remote Sensing, CRC Press, Taylor & Francis Group, 2006.
2. Lee, J.-S., Pottier, E., Polarimetric Radar Imaging: From Basics to Applications, CRC Press, Taylor & Francis Group, 2009.
3. R. Harris, 1987. "Satellite Remote Sensing, An Introduction", Routledge & Kegan Paul.

References:

1. Literature from various Journals relevant to specific topics.

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1. Name of the Course: Modern Trends in Microwave Engineering

2. LTP structure of the course: 3-1-0

3. Objective of the course: To provide information related to the present day applications so that students and researchers desirous of working on RF related applications like RF Circuit design, RF Communication or RF propagation finds this course useful.

4. Outcome of the course: Student will be able to understand present day technologies used in Microwave, their effect on human body and applications.

5. Course Plan:

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	Effect of Microwaves on human body. Medical and Civil applications of microwaves. ISM band applications.	
	Unit 2	**Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC). :** Analysis of EMI, Type of Noise and Interference, Electromagnetic Compatibility, Radiated Emission and susceptibility, Benefits of good EMC Design, Brief description of EMC regulations, Examples of EMC related problems.	
Component 2	Unit 3	Monolithic Microwave IC fabrication. RFMEMS for microwave components.	
	Unit 4	Microwave Imaging: Techniques and applications.	

6. Text Book:

1. Paul, C., Introduction to Electromagnetic Compatibility, John Wiley & Sons, 1992.
2. BehzadRazavi**,** *RF Microelectronics*, Prentice Hall; 2 edition,2012.

References:

1. Technical Notes/Application Notes of various instruments and devices.
2. Journal papers as suggested by Faculty.

ADD-ON Specialization on Photonics
(For B. Tech., ECE Students)

1. Name of the Course: Optical Electronics

2. LTP structure of the course: 3-1-0

3. Objective of the course: To let the 2nd Semester M. Tech. (ECE) students be introduced to the various optical fiber modes, configurations and various signal degradation factors associated with optical fiber. Finally to discuss about digital transmission and its associated parameters on system performance.

4. Outcome of the course: The students will learn how to handle optical systems, and to get knowledge about the construction mechanism and selection criteria of Optical fiber cables.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Electro optic effect and electro optic modulators and switches	
	Unit 2	Liquid crystal devices and spatial light modulators	
Component 2	Unit 3	Acousto-Optic effect, Acousto-Optic Tunable Filter and Deflector	
	Unit 4	Nonlinear effects in optical fibers	

6. Text Book/Refrences:

1. Optical Electronic by: Ajoy Kumar Ghatak , K. Thyagarajan

2. Optoelectronics - an Introduction – Wilson and Hawkes, Prentice Hall, 1998

7. **Reference:** -

1. Semiconductor Optoelectronic devices – Pallab Bhattacharya, Prentice Hall of India, 1995

2. Semiconductor Optoelectronics – Jasprit Singh, Tata Mc Graw Hill, 1995

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Guided Optical Component and Devices

1. **Name of the Course**: Guided Optical Component and Devices

2. **LTP structure of the course**: 3-1-0

3. **Objective of the course**: The course is aimed at teaching the basics of guided-optical media used in the communication systems. This course will cover the types of guided-media, related devices and components, operation principle, fabrication/manufacturing and its application.

4. **Outcome of the course**: The students will be able to identify the types guided media according to the application and able to analyze the performance of the system.

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Optical Fibers for Broadband Lightwave Communication: Evolutionary Trends in Design, emergence of fiber amplifiers and DWDM systems, Course wavelength division multiplexing	
	Unit 2	Development of a Polymer Optical Fiber, manufacturing and Its Application, Comparison between conventional silica fibers and POFs. Gratings in POFs.	
Component 2	Unit 3	Photonic Bandgap-Guided Bragg Fibers, Dispersion compensated Bragg fibers, fabrications, Soft glass fibers	
	Unit 4	Erbium-Doped Fiber Amplifiers: Introduction, Population Inversion and optical amplification, optical amplification in EDFAs, Gain flattening, Noise in amplification, Applications	

6. Text Book:

1. Guided Wave Optical Components and Devices: basics, Technology and Application, by Bishnu B. Pal, Elsevier Academic Press.

7. References:

1. Foundations for Guided-Wave Optics, Chin-Lin Chen, John Wiley & Sons, Inc.(2005)

Optical Communication Systems

1. Name of the Course: Optical Communication Systems

2. LTP structure of the course: 3-1-0

3. Objective of the course: To let the 2nd Semester M. Tech. (ECE) students revise basic laws of optical communication and to demonstrate their application on optical devices. Also, let them exposed to in-depth view of Advanced Optical Communication

4. Outcome of the course: The students will learn how to handle optical systems.

5. Course Plan: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	Optical Sources and Detectors	
	Unit 2	Optical Power Launching and Coupling	
Component 2	Unit 3	Optical Amplifiers and Point-to-point Optical Link Design	
	Unit 4	Introduction to WDM Concepts and Optical Network	

6. Text Book: Optical Fiber Communications by *Gred Keiser* (McGraw Hill)

7. References:

1. Optical Fiber Communications by *John M. Senior* (Pearson Education)
2. Optical Communications by Robert Gagliardi, Sherman Karp
3. Optical Communications System by *John Gowar* (Prentice Hall of India).

CMOS Photonics

1. **Name of the Course**: CMOS Photonics

2. **LTP structure of the course**: 3-1-0

3. **Objective of the course**: The course is aimed at teaching the basics and advancements in the area of CMOS photonics including integration of optical modulator, receivers etc., along with CMOS process.

4. **Outcome of the course**: Thestudents will be able to understand the principles and challenges behind the technologies employed forCMOS photonics of modern era.

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction to CMOS photonics, fundamental difference between CMOS electronics and CMOS Photonics, Reliability and compatibility issue of CMOS photonislasers on silicon	
	Unit 2	Silicon-on-insulator (SOI) Technology, Silicon waveguides, Waveguides & Refractive Index in CMOSsilicon modulators,non-linear silicon photonics,	
Component 2	Unit 3	CMOS-Photonic hybrid integration, Nanophotonics-Photonic crystals, Slow light and its applications.	
	Unit 4	phase modulators,Silicon-germaniumdetector,waveguide photo-detectors,	

6. Text Book:

1. G. T. Reed, Silicon Photonics: The state of the art, John Wiley and Sons (2008)

2. S. V. Gaponenko, Introduction to Nanophotonics, Cambridge University Press (2010).

7. References:

1. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, Wiley (2007).

2. H. Nishihara, M. Haruna, T. Suhara, Optical Integrated Circuits, Mc-Graw Hill (2008).

Optical Networks

1. Name of the Course: Optical Networks

2. LTP structure of the course: 3-1-0

3. **Objective of the course:** To let the 3rd Semester M.Tech. (ECE) students exposed to the Network aspects of optical communication and to demonstrate its application for various types of Optical Networks

4. **Outcome of the course:** The students will learn how to handle various features e.g., Routing, Congestion, WDM aspects of Optical Networks.

5. Course Plan: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	Photonic Packet Switching	
	Unit 2	Client Layers of the Optical Layer	
Component 2	Unit 3	Broadcast and Select & Wavelength Routing Networks	
	Unit 4	Optical Access Networks	

6. Text Book: "Optical Networks" by R. Ramaswami, Kumar N. Sivarajan, Galen H. Sasaki

7. References:

1. "*WDM Optical Networks : Concept, Design and Algorithms*" by C. Siva Ram Moorthy and Mohan Gurusamy, Prentice Hall of India, Ist Edition, 2002.
2. "*Fiber Optic Networks*" by P.E. Green, Jr., Prentice Hall, NJ, 1993.
3. "*Optical WDM Networks*" by Biswanath Mukherjee, Springer, 2006.
4. "*Optical Switching Networks*" by Mayer & Martin, Cambridge University Press, 2008.

Photonic Sensors

1. **Name of the Course**: Photonic Sensors

2. **LTP structure of the course**: 3-1-0

3. **Objective of the course**: The course is aimed at teaching the basics and advancements in the area of photonic sensors including various measurement techniques.

4. **Outcome of the course**: Thestudents will be able to understand the principles and technologies behind the optic based sensors in modern industrial domain

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Fibers and Integrated Optic Sensors, Microstructure Fiber Sensors, Fiber Bragg-Grating Sensors, Distributed Optical Fiber Sensors, Sensing based on Surface Plasmon Resonance	
	Unit 2	Infrared(IR) detectors, Transmission, Absorption and Scattering phenomenon, Detector types, Photovoltaic detectors, Photo diodes, MSM photo detectors, IR active and passive devices	
Component 2	Unit 3	Optical measurement principle and techniques: Optical waveguide sensors, Intensity measurement, Interferometric Measurement, Fluorescent Measurement, Surface Plasmon measurement,	
	Unit 4	Applications: Fiber optics,	

6. Text Book:

Handbook of Optical Sensors, Edited by Jose Luis Santos and FaramarzFarahi, CRC Prss, Taylor & Francis Group.

7. References:

1. Optical Sensors and Switches, by V. Ramamurthy and Kirk S. Schanze, Molecular and Supermolecular Photochemistry, Vol. 7.
2. Infrared Technology: Applications to Electrooptics, Photonic Devices, and Sensors, by A. R. Jha, Wiley

ADD-ON Minor on Photonics
(For B. Tech., IT Students)

1. Name of the Course: Optical Electronics

2. LTP structure of the course: 3-1-0

3. Objective of the course: To let the 2nd Semester M. Tech. (ECE) students be introduced to the various optical fiber modes, configurations and various signal degradation factors associated with optical fiber. Finally to discuss about digital transmission and its associated parameters on system performance.

4. Outcome of the course: The students will learn how to handle optical systems, and to get knowledge about the construction mechanism and selection criteria of Optical fiber cables.

5. Course Plan: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	Electro optic effect and electro optic modulators and switches	
	Unit 2	Liquid crystal devices and spatial light modulators	
Component 2	Unit 3	Acousto-Optic effect, Acousto-Optic Tunable Filter and Deflector	
	Unit 4	Nonlinear effects in optical fibers	

6. Text Book/Refrences:

1. Optical Electronic by: Ajoy Kumar Ghatak , K. Thyagarajan

2. Optoelectronics - an Introduction – Wilson and Hawkes, Prentice Hall, 1998

7. **Reference:** -

1. Semiconductor Optoelectronic devices – Pallab Bhattacharya, Prentice Hall of India, 1995

2. Semiconductor Optoelectronics – Jasprit Singh, Tata Mc Graw Hill, 1995

.

Guided Optical Component and Devices

1. **Name of the Course**: Guided Optical Component and Devices

2. **LTP structure of the course**: 3-1-0

3. **Objective of the course**: The course is aimed at teaching the basics of guided-optical media used in the communication systems. This course will cover the types of guided-media, related devices and components, operation principle, fabrication/manufacturing and its application.

4. **Outcome of the course**: The students will be able to identify the types guided media according to the application and able to analyze the performance of the system.

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Optical Fibers for Broadband Lightwave Communication: Evolutionary Trends in Design, emergence of fiber amplifiers and DWDM systems, Course wavelength division multiplexing	
	Unit 2	Development of a Polymer Optical Fiber, manufacturing and Its Application, Comparison between conventional silica fibers and POFs. Gratings in POFs.	
Component 2	Unit 3	Photonic Bandgap-Guided Bragg Fibers, Dispersion compensated Bragg fibers, fabrications, Soft glass fibers	
	Unit 4	Erbium-Doped Fiber Amplifiers: Introduction, Population Inversion and optical amplification, optical amplification in EDFAs, Gain flattening, Noise in amplification, Applications	

6. Text Book:

1. Guided Wave Optical Components and Devices: basics, Technology and Application, by Bishnu B. Pal, Elsevier Academic Press.

7. References:

1. Foundations for Guided-Wave Optics, Chin-Lin Chen, John Wiley & Sons, Inc.(2005)

Optical Communication Systems

1. Name of the Course: Optical Communication Systems

2. LTP structure of the course: 3-1-0

3. Objective of the course: To let the 2nd Semester M. Tech. (ECE) students revise basic laws of optical communication and to demonstrate their application on optical devices. Also, let them exposed to in-depth view of Advanced Optical Communication

4. Outcome of the course: The students will learn how to handle optical systems.

5. Course Plan: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	Optical Sources and Detectors	
	Unit 2	Optical Power Launching and Coupling	
Component 2	Unit 3	Optical Amplifiers and Point-to-point Optical Link Design	
	Unit 4	Introduction to WDM Concepts and Optical Network	

6. Text Book: Optical Fiber Communications by *Gred Keiser* (McGraw Hill)

7. References:

1. Optical Fiber Communications by *John M. Senior* (Pearson Education)
2. Optical Communications by Robert Gagliardi, Sherman Karp
3. Optical Communications System by *John Gowar* (Prentice Hall of India).

CMOS Photonics

1. **Name of the Course**: CMOS Photonics

2. **LTP structure of the course**: 3-1-0

3. **Objective of the course**: The course is aimed at teaching the basics and advancements in the area of CMOS photonics including integration of optical modulator, receivers etc., along with CMOS process.

4. **Outcome of the course**: Thestudents will be able to understand the principles and challenges behind the technologies employed forCMOS photonics of modern era.

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction to CMOS photonics, fundamental difference between CMOS electronics and CMOS Photonics, Reliability and compatibility issue of CMOS photonislasers on silicon	
	Unit 2	Silicon-on-insulator (SOI) Technology, Silicon waveguides, Waveguides & Refractive Index in CMOSsilicon modulators,non-linear silicon photonics,	
Component 2	Unit 3	CMOS-Photonic hybrid integration, Nanophotonics-Photonic crystals, Slow light and its applications.	
	Unit 4	phase modulators,Silicon-germaniumdetector,waveguide photo-detectors,	

6. Text Book:

G. T. Reed, Silicon Photonics: The state of the art, John Wiley and Sons (2008)

S. V. Gaponenko, Introduction to Nanophotonics, Cambridge University Press (2010).

7. References:

B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, Wiley (2007).

H. Nishihara, M. Haruna, T. Suhara, Optical Integrated Circuits, Mc-Graw Hill (2008).

Optical Networks

1. Name of the Course: Optical Networks

2. LTP structure of the course: 3-1-0

3. **Objective of the course:** To let the 3rd Semester M.Tech. (ECE) students exposed to the Network aspects of optical communication and to demonstrate its application for various types of Optical Networks

4. **Outcome of the course:** The students will learn how to handle various features e.g., Routing, Congestion, WDM aspects of Optical Networks.

5. Course Plan: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	Photonic Packet Switching	
	Unit 2	Client Layers of the Optical Layer	
Component 2	Unit 3	Broadcast and Select & Wavelength Routing Networks	
	Unit 4	Optical Access Networks	

6. Text Book: "Optical Networks" by R. Ramaswami, Kumar N. Sivarajan, Galen H. Sasaki

7. References:

1. "*WDM Optical Networks: Concept, Design and Algorithms*" by C. Siva Ram Moorthy and Mohan Gurusamy, Prentice Hall of India, Ist Edition, 2002.
2. "*Fiber Optic Networks*" by P.E. Green, Jr., Prentice Hall, NJ, 1993.
3. "*Optical WDM Networks*" by Biswanath Mukherjee, Springer, 2006.
4. "*Optical Switching Networks*" by Mayer & Martin, Cambridge University Press, 2008.

Photonic Sensors

1. **Name of the Course**: Photonic Sensors

2. **LTP structure of the course**: 3-1-0

3. **Objective of the course**: The course is aimed at teaching the basics and advancements in the area of photonic sensors including various measurement techniques.

4. **Outcome of the course**: Thestudents will be able to understand the principles and technologies behind the optic based sensors in modern industrial domain

5. Course Plan:

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	Fibers and Integrated Optic Sensors, Microstructure Fiber Sensors, Fiber Bragg-Grating Sensors, Distributed Optical Fiber Sensors, Sensing based on Surface Plasmon Resonance	
	Unit 2	Infrared(IR) detectors, Transmission, Absorption and Scattering phenomenon, Detector types, Photovoltaic detectors, Photo diodes, MSM photo detectors, IR active and passive devices	
Component 2	Unit 3	Optical measurement principle and techniques: Optical waveguide sensors, Intensity measurement, Interferometric Measurement, Fluorescent Measurement, Surface Plasmon measurement,	
	Unit 4	Applications: Fiber optics,	

6. Text Book:

Handbook of Optical Sensors, Edited by Jose Luis Santos and FaramarzFarahi, CRC Prss, Taylor & Francis Group.

7. References:

a) Optical Sensors and Switches, by V. Ramamurthy and Kirk S. Schanze, Molecular and Supermolecular Photochemistry, Vol. 7.

b) Infrared Technology: Applications to Electrooptics, Photonic Devices, and Sensors, by A. R. Jha, Wiley

Indian Institute of Information Technology, Allahabad
Department of Electronics and Communication Engineering
B.Tech - M.Tech.Dual Degree in General ECE
Total Credit: 160+64=224

Semester 1 (BEC - 1)				Total Credit : 20		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Physics		Core (H)	4	2–1–1	Nil
2	Linear Algebra		Core (H)	4	3–1–0	Nil
3	Introduction to Programming in C		Core (H)	4	2–1–1	Nil
4	Fundamentals of Electrical & Electronics Engg.		Core (H)	4	2–1–1	Nil
5	Professional Communication		Core (H)	2	1--0--1	Nil
6	Principles of Management		Core (H)	2	1–1–0	Nil
					11–10–8	
			Total	20	29	

Semester 2 (BEC - 2)				Total Credit : 22		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre- Requisite
1	Univariate and Multivariate Calculus		Core (H)	4	3–1–0	Nil
2	Digital System Design		Core (H)	4	2–1–1	Nil
3	Data Structures		Core (H)	4	2–1–1	Introduction to Programming in C
4	Electronic Devices and Circuits		Core (H)	4	2–1–1	Nil
5	Electromagnetic Field and Waves		Core (H)	4	3–1–0	Nil
6	Electronic Workshop		Core (H)	2	0–0–2	Nil
					12–10–10	
			Total	22	32	

Semester 3 (BEC - 3)				Total Credit : 22		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre- Requisite
1	Analog Communication		Core (H)	4	2–1–1	Nil
2	Analog Electronics		Core (H)	4	2–1–1	Electronic Devices and Circuits
3	Electrical Engineering		Core (H)	3	2–0–1	Nil
4	Electronics Measurement and Instrumentation		Core (H)	3	2–0–1	Nil
5	Micro Processor Interface and Programming		Core (H)	4	2–1–1	Nil
6	Probability and Statistics		Core (H)	4	3–1–0	Nil
					13–8–10	
			Total	22	31	

Semester 4 (BEC - 4)				Total Credit : 20		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Discrete Time Signals and Systems		Core (H)	3	2–1–0	Nil
2	Control Systems		Core (H)	4	2–1–1	Nil

3	Digital IC Design		Core (H)	3	2–0–1	Nil
4	Integrated Circuit Technology		Core (H)	3	2–1–0	Nil
5	Antenna and Wave Propagation		Core (H)	4	2–1–1	Electromagnetic Field and Waves
6	Operating Systems		Core (H)	3	2–0–1	Nil
					12–8–8	
Total				20	28	

Semester 5(BEC - 5)				Total Credit : 20		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Digital Communication		Core (H)	4	2–1–1	Nil
2	Computer Networks		Core (H)	4	2–1–1	Nil
3	Embedded System Design		Core (H)	4	3–0–1	Nil
4	Microwave Engineering		Core (H)	4	2–1–1	Nil
5	SMT Workshop		Core (H)	1	0–0–1	Nil
6	Power Electronics		Core (H)	3	2–1–0	Nil
					11–8–10	
Total				20	29	

Semester 6(BEC - 6)				Total Credit : 22		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Digital Signal Processing		Core (H)	4	2–1–1	Discrete Time Signals and Systems
2	Optical Communication		Core (H)	3	2–0–1	Nil
3	Principles of Wireless Communication		Core (H)	4	2–1–1	Nil
4	Elective 1		Core (S)	4	3–1–0	Nil
5	Elective 2		Core (S)	4	2–1–1	Nil
6	Mini Project		Core (S)	3	0–1–2	Nil
					10–10–12	
Total				22	33	

Semester 7(BMEC - 7)				Total Credit : 20		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Applied Mathematics		Core (H)	4	3-1-0	Nil
2	Programming for Engineering Applications		Core (H)	4	0-2-2	Nil
3	Digital System Design		Core (H)	4	2-1-1	Nil
4	Introduction to Microelectronics		Core (H)	4	3-0-1	Nil
5	Communication Engineering		Core (H)	4	2-1-1	Nil
					10-10-10	
Total				20	30	

Semester 8(BMEC - 8)			Total Credit : 20				
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P		Pre-Requisite
1	Elective 1		Core (S)	4	3-1-0		Nil
2	Elective 2		Core (S)	4	3-1-0		Nil
3	Elective 3		Core (S)	4	3-1-0		Nil
4	Elective 4		Core (S)	4	3-1-0		Nil
5	Independent Study		Core (S)	4	0-2-2		Nil
					12-12-4		
			Total		20	28	

Semester 10 (BMEC-9)(Summer Semester)			Total Credit : 12			
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P(hr)	Pre-Requisite
1	Mini Project		Core (H)	5	0–1–4	Nil
2	Elective 5		Core (S)	3	2–1–0	Nil
3	Elective 6		Core (S)	4	2–1–1	Nil
					4-6-10	
			Total	12	20	

Semester 10(BMEC-10)			Total Credit : 18			
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Elective 7		Core (S)	4	3-1-0	Nil
2	Elective 8		Core (S)	4	3-1-0 / 0-2-2	Nil
4	Mini Project		Core (H)	10	0-0-10	Nil
					06-04-20	
			Total	18	30	

Semester 11(BMEC-11)			Total Credit : 16			
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Thesis		Core (H)	12	0-0-12	Mini Project
2	Research Methodology		Core (H)	4	3-1-0	Nil
					3-2-24	
			Total	16	29	

Semester 12 (BMEC 12) (Summer Semester)			Total Credit : 12			
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Thesis		Core (H)	12	0–0–12	Thesis
					0–0–24	
		Total		12	24	

Till VI sem course syllabus of Dual Degree Program is same as that of B.Tech.ECE

"REFER BTech course syllabus sheet"

BMEC-7

(Enrolled Students

WILL ATTEND CLASSES WITH MEC-1)

1. Name of the Course: Applied Mathematics
2. **LTP structure of the course:** 3–1–0
3. **Objective of the course:** To make the students aware about the wonderful topics of Applied Mathematics
4. **Outcome of the course:** The student is expected to solve and apply in their research activities.
5. **Course Plan:**

Component	Unit	Topics for Coverage	Chapter No.(Optional)

Component 1	Unit 1	Analytic function of a complex variable, Calculus of residues, linear response, dispersion relations.	
	Unit 2	Analytic continuation gamma function, Mobius transforms, Multivalued functions, integral representations.	
Component 2	Unit 3	Fundamentals of Green's function, diffusion equation, non-relativistic scattering, The wave equation, rotation group	
	Unit 4	Random Variables and Random Processes	

6. **Text Book:**

1. M R Spiegel, Complex variables, Schaum Outline Series, 2000

2. M Boas, Mathematical Methods in Physical Sciences, Wiley, 1998

1. **Name of the Course: Programming for Engineering Applications**
2. **LTP structure of the course:**0–2–2
3. **Objective of the course:** To prepare the student as an independent scientific programmer.
4. **Outcome of the course:**The student is expected to apply the methods in his/her research topics.
5. **Course Plan:**

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	MATLAB programming and Simulink, Mathematica	
	Unit 2	NetSim, OptiWave, Computational Electromagnetics	
Component 2	Unit 3	HDL Tools and Programming	
	Unit 4	Software Programming	

6. **Text Book:**

1. W H Press, S ATeukolsky, W T Vetterling and B P Flannery, Numerical recipes in C: The art of scientific Computing, 2nd Edition, Cambridge University Press, 2002.

****

1. **Name of the Course**: Digital System Design
2. **LTP structure of the course**: 3-1-0
3. **Objective of the course**: To let the first year M. Tech. students exposed to CMOS digital circuit design using commercial process design kits.
4. **Outcome of the course**: The students will learn how to design digital circuits using state-of-the-art design kits.
5. **Course Plan**: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	**Static and Dynamic MOS circuits**: Basic logic gates design, Performance-Speed, Power- study and calculation, Layout design	
	Unit 2	**Combinational and Sequential Circuits**, Switching Characteristics, Timings Analysis, delay calculations, metastability, Arithmetic (adders and multipliers)	
Component 2	Unit 3	**Memory:** SRAM, DRAM design and Integration issues, Non-volatile memory design.	
	Unit 4	**Frontend, Backend Design and synthesis**: RTL and GATE level modeling for digital systems, Logic Synthesis (floorplanning, placement, routing etc).	

6. **Text Book:**

Jan M Rabaey, A. P. Chandrakasan, and B. Nikolic. Digital integrated circuits.Vol. 2. Englewood Cliffs: Prentice hall, 2002.

7. **References:**

Sung-Mo Kang, and Y. Leblebici, CMOS digital integrated circuits, Tata McGraw-Hill Education, 2003.

****

1. Name of the Course: Introduction to Microelectronics
2. **LTP structure of the course:**3–0–1
3. **Objective of the course:** To prepare the student to learn the physics of solid state devices.
4. **Outcome of the course:**The student is expected to become proficient in application of devices in real life problems.
5. **Course Plan:**

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Energy Bands and charge carriers in semiconductors, drift of carriers in electric and magnetic fields, excess carriers.	
	Unit 2	Junctions: Metal-Semiconductor junction, Transient and AC conditions.	
Component 2	Unit 3	BJT: Basic Operation &Ebers-Moll Model, Current Gain, Early Voltage	
	Unit 4	Field effect transistors: Pinch-off, saturation, C-V, I-V MOS capacitor, Threshold voltage MOSFET, DIBL, FIBL, etc.	

6. **Text Book:**

1. B G Streetman and S Banerjee, Solid State Electronic Devices, PHI, 2000

2. R F Pierret, Field Effect Devices, Addison Wesley, 1990

7. **References:**
As prescribed by Faculty.

****

1. **Name of the Course**: Communication Engineering

2. **LTP structure of the course**: 3-1-0

3. **Objective of the course**: To let the first year M. Tech. students exposed to fundamentals of communications engineering.

4. **Outcome of the course**: The students will learn the basics of the various communication theories.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Baseband and Band Pass Transmission of Digital Signals	
	Unit 2	RF Communications	
Component 2	Unit 3	Information Theory	
	Unit 4	Data Communications Protocols	

6. Reference Book:

1. A P Godse and U A Bakshi, Communication Engineering, Pearson, 2009

7. **References:**
As prescribed by Faculty.

****

BMEC-8

(Will attend classes with MEC2)

MEC - 2 Comprises of all Elective Courses, the details of Electives to be floated shall be declared on Semesterly basis, every year.

****

For Course syllabus- Plz refer M.Tech ordinance as syllabus is same with that of MEC2.

****

BMEC-9 (Summer Sem)

Mini Project- Guidelines as decided by ECE Deptt

Electives: As decided by the ECE deptt

Course details for SOME of the electives

1. Name of the Course: MIMO Communications
2. LTP structure of the course: 3-1-0
3. Objective of the course:

1. To acquire the fundamental concepts of MIMO wireless communications
2. To get familiarize with different MIMO receivers
3. To familiarize with the multi-user MIMO concepts.

4. Outcome of the course:

1. Acquire basics of spatial diversity used for wireless communication systems.
2. Understand the space-time block codes and the estimation of MIMO channels.
3. Examine the BER performance of MIMO Systems

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Modeling of wireless systems under fading channels Diversity techniques in wireless communication.	
	Unit 2	MIMO system model, Alamouti and Space-Time Codes, OSTBC codes, Estimation in MIMO Channel	
Component 2	Unit 3	MIMO Beamforming, MIMO Zero-Forcing Receiver, MIMO MMSE receiver, SVD of MIMO channel	
	Unit 4	Nonlinear MIMO Receiver, single -user MIMO, multi-user MIMO, MIMO relying	

6. Text Book:
D. Tse and P. Viswanath, Fundamentals of Wireless Communications, Cambridge University Press, 2005

7. References:
J. R. Hampton, Introduction to MIMO Communications, Cambridge University Press., 2013, ISBN: 9781107042834.

R.K. Kshetrimayum, Fundamentals of MIMO Wireless Communications, 1st ed. Cambridge University Press, 2017, ISBN: 9781108415699

1. Name of the Course: Radar and Satellite Communication
2. LTP structure of the course: 4-0-0
3. Objective of the course: To let the 7th Semester B. Tech. (ECE) students exposed to the terminology of Ranging, Detection and Space Communication.
4. Outcome of the course: The students will learn how to handle the Space Communication
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Radar Range Equation and its Analysis	
	Unit 2	CW, FM, MTI, PDR and Tracking Radar	
Component 2	Unit 3	Orbital aspects of Satellite communication and Satellite Transponder	
	Unit 4	Satellite Channel, Link design and Multiple-Access System	

6. Text Book:
M. I. Skolnik, Introduction to Radar Systems, Wiley, 2000
T. Pratt, C. W. Boston & J. E. Allnutt, Satellite Communication, Wiley, 2000
R. M. Gagliardi, Satellite Communication, Wiley, 2000

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BMEC-10

(Will attend classes with MEC 3)

MEC - 3 Comprises of Elective Courses together with a Mini Project. The details of Electives to be floated shall be declared on Semesterly basis, every year. Guidelines for the Mini Project shall be as decided by the ECE department.

****

For Course syllabus- Plz refer MTech ordinance as syllabus is same with that of MEC 3.

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BMEC-11

Research Methodology

Will do thesis (project) work as per guidelines of MEC 4

BMEC-12(Summer Sem)

Thesis: Guidelines as decided by the Deptt of ECE

Indian Institute of Information Technology, Allahabad

Department of Electronics and Communication Engineering

B.Tech - M.Tech. Dual Degree in Microelectronics

Total Credit: 160+64=224

Semester 1 (BEC - 1)				Total Credit : 20		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Physics		Core (H)	4	2–1–1	Nil
2	Linear Algebra		Core (H)	4	3–1–0	Nil
3	Introduction to Programming in C		Core (H)	4	2–1–1	Nil
4	Fundamentals of Electrical & Electronics Engg.		Core (H)	4	2–1–1	Nil
5	Professional Communication		Core (H)	2	1--0--1	Nil
6	Principles of Management		Core (H)	2	1–1–0	Nil
					11–10–8	
		Total		20	29	

Semester 2 (BEC - 2)				Total Credit : 22		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre- Requisite
1	Univariate and Multivariate Calculus		Core (H)	4	3–1–0	Nil
2	Digital System Design		Core (H)	4	2–1–1	Nil
3	Data Structures		Core (H)	4	2–1–1	Introduction to Programming in C
4	Electronic Devices and Circuits		Core (H)	4	2–1–1	Nil
5	Electromagnetic Field and Waves		Core (H)	4	3–1–0	Nil
6	Electronic Workshop		Core (H)	2	0–0–2	Nil
					12–10–10	
		Total		22	32	

Semester 3 (BEC - 3)				Total Credit : 22		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre- Requisite
1	Analog Communication		Core (H)	4	2–1–1	Nil
2	Analog Electronics		Core (H)	4	2–1–1	Electronic Devices and Circuits
3	Electrical Engineering		Core (H)	3	2–0–1	Nil
4	Electronics Measurement and Instrumentation		Core (H)	3	2–0–1	Nil
5	Micro Processor Interface and Programming		Core (H)	4	2–1–1	Nil
6	Probability and Statistics		Core (H)	4	3–1–0	Nil
					13–8–10	
		Total		22	31	

Semester 4 (BEC - 4)				Total Credit : 20		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre- Requisite
1	Discrete Time Signals and Systems		Core (H)	3	2–1–0	Nil
2	Control Systems		Core (H)	4	2–1–1	Nil
3	Digital IC Design		Core (H)	3	2–0–1	Nil

4	Integrated Circuit Technology		Core (H)	3	2–1–0	Nil
5	Antenna and Wave Propagation		Core (H)	4	2–1–1	Electromagnetic Field and Waves
6	Operating Systems		Core (H)	3	2–0–1	Nil
					12–8–8	
		Total		20	29	

Semester 5(BEC - 5)				Total Credit : 20		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Digital Communication		Core (H)	4	2–1–1	Nil
2	Computer Networks		Core (H)	4	2–1–1	Nil
3	Embedded System Design		Core (H)	4	3–0–1	Nil
4	Microwave Engineering		Core (H)	4	2–1–1	Nil
5	SMT Workshop		Core (H)	1	0–0–1	Nil
6	Power Electronics		Core (H)	3	2–1–0	Nil
					11–8–10	
		Total		20	29	

Semester 6(BEC - 6)				Total Credit : 22		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Digital Signal Processing		Core (H)	4	2–1–1	Discrete Time Signals and Systems
2	Optical Communication		Core (H)	3	2–0–1	Nil
3	Principles of Wireless Communication		Core (H)	4	2–1–1	Nil
4	Elective 1		Core (S)	4	3–1–0	Nil
5	Elective 2		Core (S)	4	2–1–1	Nil
6	Mini Project		Core (S)	3	0–1–2	Nil
					10–10–12	
		Total		22	33	

Semester 7(BMEC - 7)				Total Credit : 20		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Applied Mathematics		Core (H)	4	3-1-0	Nil
2	Programming for Engineering Applications		Core (H)	4	0-2-2	Nil
3	Digital System Design		Core (H)	4	2-1-1	Nil
4	Introduction to Microelectronics		Core (H)	4	3-0-1	Nil
5	Communication Engineering		Core (H)	4	2-1-1	Nil
					10-10-10	
		Total		20	30	

Semester 8(BMECS - 8)				Total Credit : 20		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Elective 1		Core (S)	4	3-1-0	Nil
2	Elective 2		Core (S)	4	3-1-0	Nil
3	Elective 3		Core (S)	4	3-1-0	Nil
4	Elective 4		Core (S)	4	3-1-0	Nil
5	Independent Study		Core (S)	4	0-2-2	Nil
					12-12-4	
			Total	20	28	

Semester 9 (BMECS-9)(Summer Semester)			Total Credit : 12			
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P(hr)	Pre-Requisite
1	Mini Project		Core (H)	5	0–1–5	Nil
2	Elective 5 (Department)		Core (S)	3	2–1–0	Nil
3	Elective 6 (Department/Other Department)		Core (S)	4	2–1–1	Nil
					4-6-12	
			Total	12	22	

Semester 10 (BMECS-10)				Total Credit : 18		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Elective 7		Core (S)	4	3-1-0	Nil
2	Elective 8		Core (S)	4	3-1-0 / 0-2-2	Nil
4	Mini Project		Core (H)	10	0-0-10	Nil
					06-04-20	
			Total	18	33	

Semester 11 (BMECS-11)				Total Credit : 16		
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Thesis		Core (H)	12	0-0-12	Mini Project
2	Research Methodology		Core (H)	4	3-1-0	Nil
					3-2-24	
			Total	16	29	

Semester 12 (BMECS 12)	Total Credit : 12

(Summer Semester)						
Sl.No.	Course Name	Code	Core/Elect	Credit	L-T-P	Pre-Requisite
1	Thesis		Core (H)	12	0–0–12	Thesis
					0–0–24	
			Total	12	24	

Till VI sem course syllabus of Dual Degree Program is same as that of B.Tech.ECE

"REFER BTech course syllabus sheet"

BMEC-7

(Enrolled Students

WILL ATTEND CLASSES WITH MEC-1)

1. Name of the Course: Applied Mathematics
2. **LTP structure of the course:**3–1–0
3. **Objective of the course:** To make the students aware about the wonderful topics of Applied Mathematics
4. **Outcome of the course:**The student is expected to solve and apply in their research activities.
5. **Course Plan:**

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Analytic function of a complex variable, Calculus of residues, linear response, dispersion relations.	
	Unit 2	Analytic continuation gamma function, Mobius transforms, Multivalued functions, integral representations.	
Component 2	Unit 3	Fundamentals of Green's function, diffusion equation, non-relativistic scattering, The wave equation, rotation group	
	Unit 4	Random Variables and Random Processes	

6. **Text Book:**

1. M R Spiegel, Complex variables, Schaum Outline Series, 2000

2. M Boas, Mathematical Methods in Physical Sciences, Wiley, 1998

1. Name of the Course: Programming for Engineering Applications
2. **LTP structure of the course:**0–2–2
3. **Objective of the course:** To prepare the student as an independent scientific programmer.
4. **Outcome of the course:**The student is expected to apply the methods in his/her research topics.
5. **Course Plan:**

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	MATLAB programming and Simulink, Mathematica	
	Unit 2	NetSim, OptiWave, Computational Electromagnetics	
Component 2	Unit 3	HDL Tools and Programming	
	Unit 4	Software Programming	

6. **Text Book:**

1. W H Press, S ATeukolsky, W T Vetterling and B P Flannery, Numerical recipes in C: The art of scientific Computing, 2nd Edition, Cambridge University Press, 2002.

1. **Name of the Course**: Digital System Design
2. **LTP structure of the course**: 3-1-0
3. **Objective of the course**: To let the first year M. Tech. students exposed to CMOS digital circuit design using commercial process design kits.
4. **Outcome of the course**: The students will learn how to design digital circuits using state-of-the-art design kits.
5. **Course Plan**: As per the below format only

Component	**Unit**	**Topics for Coverage**	**Chapter No.(Optional)**
Component 1	Unit 1	**Static and Dynamic MOS circuits**: Basic logic gates design, Performance-Speed, Power- study and calculation, Layout design	
	Unit 2	**Combinational and Sequential Circuits**, Switching Characteristics, Timings Analysis, delay calculations, metastability, Arithmetic (adders and multipliers)	
Component 2	Unit 3	**Memory:** SRAM, DRAM design and Integration issues, Non-volatile memory design.	
	Unit 4	**Frontend, Backend Design and synthesis**: RTL and GATE level modeling for digital systems, Logic Synthesis (floorplanning, placement, routing etc).	

6. **Text Book:**

1. Jan M Rabaey, A. P. Chandrakasan, and B. Nikolic. Digital integrated circuits.Vol. 2. Englewood Cliffs: Prentice hall, 2002.

7. **References:-**

1. Sung-Mo Kang, and Y. Leblebici, CMOS digital integrated circuits, Tata McGraw-Hill Education, 2003.

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1. Name of the Course: Introduction to Microelectronics
2. **LTP structure of the course:**3–1–0
3. **Objective of the course:** To prepare the student to learn the physics of solid state devices.
4. **Outcome of the course:**The student is expected to become proficient in application of devices in real life problems.
5. **Course Plan:**

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Energy Bands and charge carriers in semiconductors, drift of carriers in electric and magnetic fields, excess carriers.	
	Unit 2	Junctions: Metal-Semiconductor junction, Transient and AC conditions.	
Component 2	Unit 3	BJT: Basic Operation &Ebers-Moll Model, Current Gain, Early Voltage	
	Unit 4	Field effect transistors: Pinch-off, saturation, C-V, I-V MOS capacitor, Threshold voltage MOSFET, DIBL, FIBL, etc.	

6. **Text Book:**

B G Streetman and S Banerjee, Solid State Electronic Devices, PHI, 2000

R F Pierret, Field Effect Devices, Addison Wesley, 1990

7. **References:**
As prescribed by Faculty.

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1. **Name of the Course**: Communication Engineering

2. **LTP structure of the course**: 3-1-0

3. **Objective of the course**: To let the first year M. Tech. students exposed to fundamentals of communications engineering.

4. **Outcome of the course**: The students will learn the basics of the various communication theories.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Baseband and Band Pass Transmission of Digital Signals	
	Unit 2	RF Communications	
Component 2	Unit 3	Information Theory	
	Unit 4	Data Communications Protocols	

6. Reference Book:

A P Godse and U A Bakshi, Communication Engineering, Pearson, 2009

7. **References:**
As prescribed by Faculty.

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BMECS-8

(Will attend classes with MECS 2)

MECS- 2 Comprises of all Elective Courses, the details of Electives to be floated shall be declared on Semesterly basis, every year.

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For Course syllabus- Plz refer MTech ordinance as syllabus is same with that of MEC2.

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BMECS-9 (Summer Sem)

Mini Project- Guidelines as decided by ECE Deptt
Electives: As decided by the ECE deptt

Course details for SOME of the electives

1. Name of the Course: MIMO Communications
2. LTP structure of the course: 3-1-0
3. Objective of the course:

m. To acquire the fundamental concepts of MIMO wireless communications
n. To get familiarize with different MIMO receivers
o. To familiarize with the multi-user MIMO concepts.

4. Outcome of the course:

m. Acquire basics of spatial diversity used for wireless communication systems.
n. Understand the space-time block codes and the estimation of MIMO channels.
o. Examine the BER performance of MIMO Systems

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Modeling of wireless systems under fading channels Diversity techniques in wireless communication.	
	Unit 2	MIMO system model, Alamouti and Space-Time Codes, OSTBC codes, Estimation in MIMO Channel	
Component 2	Unit 3	MIMO Beamforming, MIMO Zero-Forcing Receiver, MIMO MMSE receiver, SVD of MIMO channel	
	Unit 4	Nonlinear MIMO Receiver, single -user MIMO, multi-user MIMO, MIMO relying	

6. Text Book:
D. Tse and P. Viswanath, Fundamentals of Wireless Communications, Cambridge University Press, 2005

7. References:
J. R. Hampton, Introduction to MIMO Communications, Cambridge University Press., 2013, ISBN: 9781107042834.

R.K. Kshetrimayum, Fundamentals of MIMO Wireless Communications, 1st ed. Cambridge University Press, 2017, ISBN: 9781108415699

1. Name of the Course: Radar and Satellite Communication
2. LTP structure of the course: 3-1-0
3. Objective of the course: To let the 7th Semester B. Tech. (ECE) students exposed to the terminology of Ranging, Detection and Space Communication.
4. Outcome of the course: The students will learn how to handle the Space Communication
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Radar Range Equation and its Analysis	
	Unit 2	CW, FM, MTI, PDR and Tracking Radar	
Component 2	Unit 3	Orbital aspects of Satellite communication and Satellite Transponder	
	Unit 4	Satellite Channel, Link design and Multiple-Access System	

6. Text Book:
M. I. Skolnik, Introduction to Radar Systems, Wiley, 2000
T. Pratt, C. W. Boston & J. E. Allnutt, Satellite Communication, Wiley, 2000
R. M. Gagliardi, Satellite Communication, Wiley, 2000

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BMECS-10

(Will attend classes with MECS 3)

MECS- 3 Comprises of Elective Courses together with a Mini Project. The details of Electives to be floated shall be declared on Semesterly basis, every year. Guidelines for the Mini Project shall be as decided by the ECE department.

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For Course syllabus- Plz refer MTech ordinance as syllabus is same with that of MECS 3.

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BMECS-11

Research Methodology

Will do thesis (project) work as per guidelines of MECS 4

BMECS-12(Summer Sem)

Thesis: Guidelines as decided by the Deptt of ECE

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