Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Electronics & Communication Engineering

(Applicable from the academic session 2018-2019)

Curriculum Structure

2nd Year: 3rd Semester							
A. Theory							
Sl. No.	**Subject Code**	**Theory**	**Contact Hours/week**				**Credit Points**
			L	**T**	**P**	**Total**	
1.	EC301	Electronic Devices	3	0	0	3	3
2.	EC302	Digital System Design	3	0	0	3	3
3.	EC303	Signals and Systems	3	0	0	3	3
4.	EC304	Network Theory	3	0	0	3	3
5.	ES-CS301	Data Structure & Algorithm (ES)	3	0	0	3	3
6.	BS-M301	Mathematics III (Probability &Statistics)(BS)	3	0	0	3	3
Total Theory						**18**	**18**
B. Practical							
7.	EC391	Electronic Devices Lab.	0	0	2	2	1
8.	EC392	Digital System Design Lab.	0	0	2	2	1
9	ES-CS391	Data Structure Lab(ES)	0	0	2	2	1
Total Practical						**6**	**3**
Total Credits						**24**	**21**
C. Non Credit Course							
	MC381	Environmental Science	2	0	0	2	0

2ndYear: 4th Semester							
A. Theory							
Sl. No.	**Subject Code**	**Theory**	**Contact Hours/week**				**Credit Points**
			L	**T**	**P**	**Total**	
1.	EC401	Analog Communication	3	0	0	3	3
2.	EC402	Analog Electronic Circuits	3	0	0	3	3
3.	EC403	Microprocessor &Microcontrollers	3	0	0	3	3
4.	ES-CS401	Design and Analysis of Algorithm(ES)	3	0	0	3	3
5.	BS-M401	Numerical Methods(BS)	2	0	0	2	2
Total Theory						**14**	**14**
B. Practical							
6.	EC491	Analog Communication Lab	0	0	2	2	1
7.	EC492	Analog Electronic Circuits Lab.	0	0	2	2	1
8	EC493	Microprocessor & Microcontrollers Lab	0	0	2	2	1
9	BS-M(CS)491	Numerical Methods Lab	0	0	2	2	1
10	HS-HU481	Soft Skill Development Lab	0	0	2	2	1
Total Practical						**10**	**5**
Total Credits						**24**	**19**

3rd Year: 5th Semester							
A. Theory							
Sl. No.	**Subject Code**	**Theory**	**Contact Hours/week**				**Credit Points**
			L	**T**	**P**	**Total**	
1.	EC501	Electromagnetic Waves	3	0	0	3	3
2.	EC502	Computer Architecture	3	0	0	3	3
3.	EC503	Digital Communication & Stochastic Process	3	1	0	4	3.5
4.	EC504	Digital Signal Processing	3	0	0	3	3
5.	PE-EC505 A/B/C/D	Program Elective I	3	0	0	3	3
6.	OE-EC506 A/B/C/D	Open Elective I	3	0	0	3	3
Total Theory						**19**	**18.5**
B. Practical							
7.	EC591	Electromagnetic Wave Lab	0	0	2	2	1
8.	EC592	Digital Communication Lab.	0	0	2	2	1
9.	EC593	Digital Signal Processing Lab.	0	0	2	2	1
Total Practical						**6**	**3**
Total Credits						**25**	**21.5**

3rd Year: 6th Semester							
A. Theory							
Sl. No.	**Subject Code**	**Theory**	**Contact Hours/week**				**Credit Points**
			L	**T**	**P**	**Total**	
1.	EC601	Control System & Instrumentation	3	0	0	3	3
2.	EC602	Computer Network	3	0	0	3	3
3.	PE-EC603	Program Elective II	3	0	0	3	3
4.	OE-EC604	Open Elective II	3	0	0	3	3
5.	HS-HU601	Economics for Engineers	3	0	0	3	3
Total Theory						**15**	**15**
B. Practical							
6.	EC691	Computer Network Lab.	0	0	2	2	1
7.	EC692	Control System and Instrumentation Lab.	0	0	2	2	1
8.	EC693	Mini Project/ Electronic Design Workshop	0	0	4	4	2
Total Practical						**8**	**4**
Total Credits						**23**	**19**
9	MC681	Universal Human Values	2	0	0	2	0

4th Year: 7th Semester							
A. Theory							
Sl. No.	**Subject Code**	**Theory**	**Contact Hours/week**				**Credit Points**
			L	**T**	**P**	**Total**	
1.	PE-EC701	Program Elective -3	3	0	0	3	3
2.	PE-EC702	Program Elective -4	3	0	0	3	3
3.	PE-EC703	Program Elective -5	3	0	0	3	3
4.	OE-EC704	Open Elective - 3	3	0	0	3	3
5.	HS-HU701	Principles of Management & OB	4	0	0	4	4
Total Theory						**16**	**16**
B. Practical							
6.	EC782	Project Stage – I	0	0	8	8	4
7.	EC781	Industrial Training	During Semester Break(6th & 7th)				1
			Contact Hours/week as per Industrial Training Authority				
Total Practical						**8**	**5**
Total Credits						**24**	**21**

4th Year: 8th Semester							
A. Theory							
Sl. No.	**Subject Code**	**Theory**	**Contact Hours/week**				**Credit Points**
			L	**T**	**P**	**Total**	
1.	PE-EC801	Program Elective – 6	3	0	0	3	3
2.	PE-EC802	Program Elective - 7	3	0	0	3	3
3.	OE-EC803	Open Elective - 4	3	0	0	3	3
4.	OE-EC804	Open Elective - 5	3	0	0	3	3
Total Theory						**12**	**12**
B. Practical							
5.	EC881	Project Stage – II	0	0	15	15	7.5
6.	EC891	Grand Viva					1.5
Total Practical						**15**	**9**
Total Credits						**27**	**21**

Course Code : EC 301	**Category :** Core Courses
Course Title : Electronic Devices	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites:	

Detailed contents:

Module I **6L**

Energy bands & Current Carriers in Semiconductors: Bonding Forces in Solids, Energy Bands theory in crystals (Qualitative Analysis), Metals, Semiconductors, & Insulators, Fermi-Level, Intrinsic and Extrinsic Semiconductors, Concept of Holes, Carrier Concentration. and Mobility, diffusion and drift of carriers, continuity equation, Injected minority carrier charge, Recombination and generation of charge carriers. Generation and recombination of carriers; Poisson and continuity equation

Module II **10**L

P-N junction: Physical Description of p-n junction, Basic device technologies for fabrication of a p-n junction, I-Vcharacteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode

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Bipolar Junction Transistor: Basic Construction, I-V characteristics, Ebers-Moll Model.

Module III **6L**

MOSFET: MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor

MODULE IV **10L**

Opto–Electronics: Optical absorption in semiconductors, photovoltaic effects, solar cells (p-n junction), Photoconductors, Photodiode, PIN photodiode, Avalanche photodiode, Phototransistor, LED, Semiconductor Laser (p-n junction)

Integrated circuit: fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

Text /Reference Books:

1. G. Streetman, and S. K. Banerjee, “Solid State Electronic Devices,” 7th edition, Pearson,2014.
2. D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
3. S. M. Sze and K. N. Kwok, “Physics of Semiconductor Devices,” 3rd edition, John Wiley & Sons, 2006.
4. C.T. Sah, “Fundamentals of solid state electronics,” World Scientific Publishing Co. Inc, 1991.

5. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1. Differentiate the conduction techniques in semi-conductor materials.
CO2. Analyze characteristics of Semi-conductor diodes and solve problems.
CO3. Analyze characteristics of Bi-polar Transistors and solve problems.
CO4. Analyze characteristics of MOS Transistors and solve problems.
CO5. Differentiate between different Opto-electronic devices.

Course Code : EC 302	**Category :** Core Courses
Course Title : Digital System Design	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites:	

Detailed contents:

Module I **10L**

Review of Number System, Signed and Unsigned Number.

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh's map, Binary codes, Code Conversion.

MSI devices like Comparators, Multiplexers, Encoder, Decoder, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Fast adders, Barrel shifter and ALU.

Module II **6L**

Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM. Designing synchronous circuits like Synchronous Counter, Pulse train generator, Pseudo Random Binary Sequence generator,

Module III **8L**

Logic Families and Semiconductor Memories: TTL, ECL, CMOS families

Semiconductor Memories, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

Different types of A/D and D/A conversion techniques. Sample & Hold Cirtcuit

Module IV **8L**

VLSI Design flow: Design entry Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation
VHDL constructs and codes for combinational and sequential circuits.

Text/Reference Books:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Schilling & Belove, Digital Integrated Electronics, Tata McGraw Hill,
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition ,2006.
4. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

Course outcomes:

At the end of this course students will demonstrate the ability to

1. Design and analyze combinational logic circuits
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design & analyze synchronous sequential logic circuits

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Course Code : EC 303	**Category :** Core Courses
Course Title : Signals and System	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites:	

Detailed contents:

Module I **6L**

Signals and systems as seen in everyday life, and in various branches of engineering and science.

Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.

Module II **6L**

Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs. Characterization of causality and stability of linear shift invariant systems. System representation through differential equations.

Module III **8L**

Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases.

Module IV **8L**

Evolution of Transforms: Fourier Transform, Laplace Transform , Z-transform (single sided and Double sided)

The Laplace Transform, notion of eigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, , solution to differential equations and system behavior using Laplace Transformation

The z-Transform for discrete time signals and systems- eigen functions, region of convergence, z-domain analysis.

Module V **4L**

The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.

Text/Reference books:

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
3. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
5. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
6. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.
7. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
8. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003.
9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.
10. Ashok Ambardar,"Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.

Course outcomes:

At the end of this course students will demonstrate the ability to

1. Analyze different types of signals
2. Represent continuous and discrete systems in time and frequency domain using different transforms
3. Investigate whether the system is stable
4. Sampling and reconstruction of a signal

Course Code : EC 304	**Category :** Core Courses
Course Title : Network Theory	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites:	

Detailed contents:

Module I **8L**

Node and Mesh Analysis, matrix approach of network containing voltage and current sources, and reactances, source transformation and duality. Network theorems: Superposition, reciprocity,
Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC. circuits.

Module II **6L**

Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.

Module III **6L**
Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.

Module IV **12L**

Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem and Two four port network and interconnections, Behaviors of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.

Basic idea of Circuit Synthesis, Cauer & foster forms, examples

Text/Reference Books

1. Van, Valkenburg.; "Network analysis"; Prentice hall of India, 2000
2. Sudhakar, A., Shyammohan, S. P.; "Circuits and Network"; Tata McGraw-Hill New Delhi, 1994.
3. A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education

Course Outcomes:
At the end of this course students will demonstrate the ability to
1. Understand basics electrical circuits with nodal and mesh analysis.

2. Appreciate electrical network theorems.
3. Apply Laplace Transform for steady state and transient analysis.
4. Determine different network functions.
5. Appreciate the frequency domain techniques.

Course Code : ES-CS 301	**Category :** Engineering Science Course
Course Title : Data Structure & Algorithm	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites:	

Objectives of the course:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures

Detail Contents:

Module 1 **6L**

Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off.

Searching: Linear Search and Binary Search Techniques and their complexity analysis.

Module 2: **8L**

Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation -corresponding algorithms and complexity analysis. ADT queue,

Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Module 3: **8L**

Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

Module 4: **8L**

Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Suggested books:

1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

Suggested reference books:

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. "How to Solve it by Computer", 2nd Impression by R.G. Dromey, Pearson Education.

Course outcomes

1. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
2. For a given Search problem (Linear Search and Binary Search) student will able to implement it.
3. For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
4. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
5. Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

Course Code : BS-M 301	**Category :** Basic Science Course
Course Title : Mathematics III (Probability & Statistics)	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites:	

Detailed contents:

Module 1: Basic Probability: **8L**
Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Module 2: Continuous Probability Distributions: **4L**
Continuous random varibales and their properties, distribution functions and densities, normal, exponential and gamma densities.

Module 3: Bivariate Distributions: **4L**
Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module 4: Basic Statistics: **6L**
Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression - Rank correlation.

Module 5: Applied Statistics: **6L**
Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Module 6: Small samples: **4L**
Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Suggested Text/Reference Books

(i) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
(ii) P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
(iii) S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
(iv) W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.

(v) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
(vi) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
(vii) Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

Course Outcomes

The objective of this course is to familiarize the students with statistical techniques. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

The students will learn:

- The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
- The basic ideas of statistics including measures of central tendency, correlation and regression.
- The statistical methods of studying data samples.

Course Code : EC 391	**Category :** Core Courses
Course Title : Electronic Devices Lab	**Semester** : Third
L-T-P : **0-0-2**	**Credit:1**
Pre-Requisites:	

Detailed contents:

1. identifying and study of different components like resistor, capacitors, diodes, LED, Transistors, FET(JFET & MOSFET) etc
2. Study of different instruments used in the laboratories like, power supply, Oscilloscope, Multi-meter etc.
3. CHARACTERISTICS OF PN JUNCTION DIODE
   a) To Plot the Volt Ampere Characteristics of PN Junction Diode under Forward and Reverse Bias Conditions.
   b) To find the Cut-in voltage, Static Resistance, Dynamic Resistance for Forward Bias & Reverse Bias
4. CHARACTERISTICS OF ZENER DIODE & LOAD REGULATION
   a) To Obtain the Forward Bias and Reverse Bias characteristics of a Zener diode.
   b) Find out the Zener Break down Voltage from the Characteristics.
   c) To Obtain the Load Regulation Characteristics.
5. COMMON BASE BIPOLAR TRANSISTOR CHARACTERISTICS
   a) To plot the Input and Output characteristics of a transistor connected in Common Base Configuration and to find the h – parameters from the characteristics.
6. COMMON EMITTER BIPOLAR TRANSISTOR CHARACTERISTICS
   a) To plot the Input and Output characteristics of a transistor connected in Common Emitter Configuration and to find the h – parameters from the characteristics
7. DESIGN SELF BIAS BJT CIRCUIT
8. JFET DRAIN & TRANSFER CHARACTERISTICS (COMMON SOURCE)
   a) Drain characteristics
   b) Transfer Characteristics.
   c) To find rd, gm, and μ from the characteristics.
9. Study Characteristics of Photo transistor
10. Study Characteristics of LED & LDR

Course Outcome:

a) An ability to verify the working of different diodes, transistors, CRO probes and measuring instruments. Identifying the procedure of doing the experiment.
b) Ability to understand the characteristics of BJT and FET and how to Determine different parameters for designing purpose..
c) Ability to understand properties of photoelectric devices
d) Ability to measure and record the experimental data, analyze the results, and prepare a formal laboratory report.

Course Code : EC 392	**Category :** Core Courses
Course Title : Digital System Design Lab	**Semester** : Third
L-T-P : **0-0-2**	**Credit:1**
Pre-Requisites:	

Detailed contents:

1. Introduction to Digital Electronics Lab- Nomenclature of Digital Ics, Specifications, Study of the Data Sheet, Concept of Vcc and Ground, Verification of the Truth Tables of Logic Gates using TTL ICs.
2. Implementation of the Given Boolean Function using Logic Gates in Both Sop and Pos Forms.
3. Verification of State Tables of Rs, J-k, T and D Flip-Flops using NAND & NOR Gates
4. Implementation and Verification of Decoder/De-Multiplexer and Encoder using Logic Gates.
5. Implementation of 4x1 Multiplexer using Logic Gates.
6. Implementation of 4-Bit Parallel Adder Using 7483 IC.
7. Design , and Verify the 4- Bit Synchronous Counter
8. Design, and Verify the 4-Bit Asynchronous Counter.
9. Simulation of MOS Inverter with different loads using PSPICE software
10. Simulation of CMOS Inverter for different parameters *Kn*, *Kp* as a design variable in suitable circuit simulator software.
11. Design of a 4-bit Multiplexer using VHDL\Verilog
12. Design of a decade counter using VHDL\Verilog.
13. Design of a 3-input NAND gate and its simulation using suitable logic simulator

Book List

1. Douglas L.Perry**,** “VHDL: Programming by Example”, McGraw-Hill, 2002.
2. Charles H. Roth, Lizy Kurian John, “Digital systems design using VHDL”, Thomson, 2008.

Course Code : ES-CS 391	**Category :** Engineering Science Courses
Course Title : Data Structure Lab	**Semester** : Third
L-T-P : **0-0-2**	**Credit:1**
Pre-Requisites:	

Experiments should include but not limited to :

Experiments should include but not limited to :

Implementation of array operations:

Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting elements Merging Problem : Evaluation of expressions operations on Multiple stacks & queues :

Implementation of linked lists: inserting, deleting, and inverting a linked list.

Implementation of stacks & queues using linked lists:

Polynomial addition, Polynomial multiplication

Sparse Matrices : Multiplication, addition.

Recursive and Nonrecursive traversal of Trees

Threaded binary tree traversal. AVL tree implementation

Application of Trees. Application of sorting and searching algorithms

Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.

Course Code : EC 401	**Category :** Core Courses
Course Title : Analog Communication	**Semester** :Four
L-T-P : 3-0-0	**Credit:3**
Pre-Requisites:	

Detailed contents:

Mod-1 Introduction to Analog Communication: **8L**
Elements of communication system - Transmitters, Transmission channels & receivers (1), Concept of modulation, its needs (1).

Continuous Wave Linear Modulation:

a) Amplitude modulation(AM-DSB/TC): Time domain representation of AM signal (expression derived using a single tone message), modulation index , frequency domain (spectral) representations, illustration of the carrier and side band components; transmission bandwidth for AM; Phasor diagram of an AM signal;
Calculation of Transmitted power & sideband power & Efficiency ; concept of under, over and critical modulation of AM-DSB-TC.

b) Other Amplitude Modulations: Double side band suppressed carrier (DSBSC) modulation: time and frequency domain expressions, bandwidth and transmission power for DSB. Single side band modulation (SSB) both TC & SC and only the basic concept of VSB, Spectra and band-width.

Mod-2 Generation & Detection of Amplitude Modulation: **8L**
a) Generation of AM: Concept of i) Gated and ii) Square law modulators, Balanced Modulator.
b) Generation of SSB: Filter method, Phase shift method and the Third method
Demodulation for Linear Modulation:
Demodulation of AM signals: Detection of AM by envelope detector , Synchronous detection for AM-SC, Effects of Frequency & Phase mismatch, Corrections. Principle of Super heterodyne receivers: Super heterodyning principle, intermediate frequency, Local oscillator frequency, image frequency.

Mod-3 Angle Modulation: **8L**
a) Frequency Modulation (FM) and Phase Modulation (PM): Time and Frequency domain representations, Spectral representation of FM and PM for a single tone message, Bessel's functions and Fourier series. ; Phasor diagram ;
b) Generation of FM & PM: Narrow and Wide-band angle modulation, Basic block diagram representation of generation of FM & PM, Concept of VCO & Reactance modulator

c) Demodulation of FM and PM: Concept of frequency discriminators , Phase Locked Loop

Mod - 4 Multiplexing **8L**

a) Frequency Division Multiplexing, Time Division Multiplexing, (FDM)
b) Stereo - AM and FM: Basic concepts with block diagrams
c) Random Signals and Noise in Communication System:
i) Noise in Communication systems - Internal & External noise, Noise Temperature, Signal-to-Noise ratio, White noise, thermal noise, Figure of Merit.
ii)Noise performance in Analog Communication systems: SNR calculation for DSB/TC, DSB-SC, SSB-TC, SSB-SC & FM

Text Books:

7. Taub and Schilling , “Principles of Communication Systems”, 2nd ed., Mc-Graw Hill
8. B.P.Lathi -Communication Systems- BS Publications
9. V Chandra Sekar - Analog Communication- Oxford University Press

References:

1. Carlson—Communication System,4/e , Mc-Graw Hill
2. Proakis & Salehi Fundamentals of Communication Systems- Pearson
3. Singh & Sapre—Communication Systems: 2/e, TMH
4. P K Ghosh- Principles of Electrical Communications- University Press
5. L.W.Couch Ii, “Digital and Analog Communication Systems”, 2/e, Macmillan Publishing
6. Blake, Electronic Communication Systems- Cengage Learning
7. S Sharma, Analog Communication Systems- Katson Books

Learning outcome:

Module - 1: The learner must be able to appreciate the need for modulation and calculate the antenna size for different carrier frequencies.
From the functional representation of the modulated carrier wave, the learner must be able to identify the type of modulation, calculate the side-band frequencies, identify the modulating and carrier frequencies, decide the type of generation method to be adopted. Solve problems.

Module - 2: After understanding the basic concepts the learner must be able to compare between the different demodulation methods, design an envelope detector, calculate the IF and image frequencies for the superheterdyne receivers given the carrier and modulating frequencies, calculate the oscillator frequency.

Module - 3: From the functional representation of the modulated carrier wave, the learner must be able to identify the type of modulation, calculate the side-band frequencies, identify the modulating and carrier frequencies, decide the type of generation method to be adopted. Solve problems.

Module - 4: Appreciate the importance of Multiplexing, find out their application areas. The learner must be able to calculate the Noise temperature & SNR for different systems, also compare between the performance of the different modulation methods by comparing their SNR.

Course Code : EC 402	**Category :** Core Courses
Course Title : Analog Electronic Circuits	**Semester** : Four
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites:	

Detailed contents:

Module I **10L**

Diode Circuits: Rectifiers, Clipper, Clamper

Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier.

Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.

Module II **6L**

High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.

Module III **6L**

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

Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load.

Module IV **10L**

Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR.

OP-AMP: Basic structure and characteristics, inverting and non-inverting amplifiers

OP-AMP applications: Integrator and differentiator, summing amplifier, , Schmitt trigger and its applications.

Active filters: Low pass, high pass, band pass and band stop, design guidelines.

Text/Reference Books:

1. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
2. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
3. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
4. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College11 Publishing, Edition IV
6. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the characteristics of diodes and transistors
2. Design and analyze various rectifier and amplifier circuits
3. Design sinusoidal and non-sinusoidal oscillators
4. Understand the functioning of OP-AMP and design OP-AMP based circuits

Course Code : EC 403	**Category :** Core Courses
Course Title : Microprocessor & Microcontroller	**Semester** : Four
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites:	

Detailed contents:

Module I **10L**
Microprocessors 8085 and 8086- Pin description, memory, data structure/ access. Overview of microcomputer systems and their building blocks, memory interfacing, concepts of interrupts and Direct Memory Access (DMA), instruction sets of microprocessors (with examples of 8085 and 8086

Module II **8L**

Interfacing with peripherals- timer, serial I / O, parallel I / O, A/D and D/A converters; Arithmetic coprocessors, System level interfacing design.

Module III **8L**

Concepts of virtual memory, Cache memory; Advanced coprocessor architectures- 286, 486, Pentium;
Microcontrollers 8051 systems- pin and port description.

Module IV **6L**

Introduction to RISC processors; ARM microcontrollers interface design.

Text/Reference Books:

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996
2. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface. Morgan Kaufman Publishers.
3. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.
4. Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996.
5. Keneth Ayala, keneth. J. Ayala- The 8086 Microprocessor: Programming and interfacing the PC- West Pub.

Course Outcomes:
At the end of this course students will demonstrate the ability to
1. Do assembly language programming
2. Do interfacing design of peripherals like, I/O, A/D, D/A, timer etc.
3. Develop systems using different microcontrollers
4. Understand RSIC processors and design ARM microcontroller based systems

Course Code : ES-CS 401	**Category :** Engineering Science Course
Course Title : Design & Analysis of Algorithm	**Semester** : Four
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites:	

Objectives of the course

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis. synthesize efficient algorithms in common engineering design situations.

Detailed contents:

Module 1: **8L**

Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds - best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

Module 2: **8L**

Fundamental Algorithmic Strategies: Brute-Force, Greedy,Dynamic Programming, Branchand-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving , Bin Packing, Knap Sack TSP. Heuristics -characteristics and their application domains.

Module 3: **6L**

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

Module 4: **6L**

Tractable and Intractable Problems: Computability of Algorithms, Computability classes - P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.

Module 5: **4L**

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP - P SPACE

Suggested books:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.

2. Fundamentals of Algorithms - E. Horowitz et al.

Suggested reference books

1. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
2. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition,
   Michael T Goodrich and Roberto Tamassia, Wiley.
3. Algorithms—A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley,
   Reading, MA.

Course Outcomes

1. For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms .
2. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.
3. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.
4. Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.
5. For a given model engineering problem model it using graph and write the corresponding algorithm to solve the problems.
6. Explain the ways to analyze randomized algorithms (expected running time,
   probability of error).
7. Explain what an approximation algorithm is. Compute the approximation factor of an approximation algorithm (PTAS and FPTAS).

Course Code : BS-M 401	**Category :** Basic Science Course
Course Title : Numerical Methods	**Semester** : Four
L-T-P : **2-0-0**	**Credit:2**
Pre-Requisites:	

Detailed contents:

Module I **10L**

Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors.

Interpolation: Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation.
Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms.

Module II **8L**

Numerical solution of a system of linear equations:
Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method.
Numerical solution of Algebraic equation: Bisection method, Regula-Falsi method, Newton-Raphson method.

Module III **4L**

Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference
method. (6)

Text Books:

1. C.Xavier: C Language and Numerical Methods.
2. Dutta & Jana: Introductory Numerical Analysis.
3. J.B.Scarborough: Numerical Mathematical Analysis.
4. Jain, Iyengar , & Jain: Numerical Methods (Problems and Solution).

References:

1. Balagurusamy: Numerical Methods, Scitech.
2. Baburam: Numerical Methods, Pearson Education.
3. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.
4. Soumen Guha & Rajesh Srivastava: Numerical Methods, OUP.
5. Srimanta Pal: Numerical Methods, OUP.

Course Code : EC 491	**Category :** Core Courses
Course Title : Analog Communication Lab	**Semester** : Four
L-T-P : **0-0-2**	**Credit:1**
Pre-Requisites:	

Detailed contents:

1. Measurement of modulation index of an AM signal.
2. Measurement of output power with varying modulation index an AM signal(for both DSB- & SSB).
3. Measurement of distortion of the demodulated output with varying modulation index of an AM signal (for both DSB-SC & SSB).
4. Measurement of power of different frequency components of a frequency modulated signal & the measurement of the bandwidth.
5. Design and set up a PLL using VCO & to measure the lock frequency.
6. Design and set up a FM demodulator using PLL.
7. Measurement of SNR of a RF amplifier.
8. Measurement of selectivity, sensitivity, fidelity of a superheterodyne receiver.
9. One innovative experiment.

Course Code : EC 492	**Category :** Core Courses
Course Title : Analog Electronic Circuits Lab	**Semester** : Four
L-T-P : **0-0-2**	**Credit:1**
Pre-Requisites:	

Detailed contents:

1. Conduct experiment to test diode clipping (single/double ended) and clamping circuits (positive/negative).
2. Design and set up the following rectifiers with and without filters and to determine ripple factor and rectifier efficiency:
   (a). Full Wave Rectifier (b). Bridge Rectifier
3. Design and set up the BJT common emitter amplifier using voltage divider bias with and without feedback and determine the gain- bandwidth product from its frequency response.
4. Set-up and study the working of complementary symmetry class B push pull power amplifier and calculate the efficiency
5. Realize BJT Darlington Emitter follower with and without bootstrapping and determine the gain, input and output impedances
6. Conduct an experiment on Series Voltage Regulator using Zener diode and power transistor to determine line and load regulation characteristics.
7. Design and set-up the following tuned oscillator circuits using BJT, and determine the frequency of oscillation.
   (a) Hartley Oscillator (b) Colpitts Oscillator
8. Plot the transfer and drain characteristics of n-channel MOSFET and calculate its parameters, namely; drain resistance, mutual conductance and amplification factor.
9. Design, setup and plot the frequency response of Common Source JFET/MOSFET amplifier and obtain the bandwidth.

Course Outcome:

Students will be able to:

CO1: Design and test rectifiers, clipping circuits, clamping circuits and voltage regulators.
CO2: Compute the parameters from the characteristics of JFET and MOSFET devices.
CO3: Design, test and evaluate BJT amplifiers in CE configuration.
CO4: Design and test JFET/MOSFET amplifiers.
CO5: Design and test a power amplifier.
CO6: Design and test various types of oscillators.

Course Code : EC 493	**Category :** Core Courses
Course Title : Microprocessor & Microcontroller Lab	**Semester** : Four
L-T-P : **0-0-2**	**Credit:1**
Pre-Requisites:	

Detailed contents:

1. Familiarization with 8085 & 8051simulator on PC.
2. Study of prewritten programs using basic instruction set (data transfer, Load/Store, Arithmetic, Logical) on the KIT. Assignments based on above
3. **Programming using kit and simulator for:**

(i) Table look up
(ii) Copying a block of memory
(iii) Shifting a block of memory
(iv) Packing and unpacking of BCD numbers
(v) Addition of BCD numbers
(vi) Binary to ASCII conversion
(vii) String Matching, Multiplication using shift and add method and Booth's Algorithm

4. Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit e.g. subroutine for delay, reading switch state and glowing LEDs accordingly.
5. Study of timing diagram of an instruction on oscilloscope..
6. Interfacing of 8255: Keyboard and Multi-digit Display with multiplexing using 8255
7. Study of 8051 Micro controller kit and writing programs as mentioned in S/L3. Write programs to interface of Keyboard, DAC and ADC using the kit.
8. Serial communication between two trainer kits

Course Code : BS-M (CS)491	**Category :** Basic Science Courses
Course Title : Numerical Methods Lab	**Semester** : Four
L-T-P : **0-0-2**	**Credit:1**
Pre-Requisites:	

Detailed contents:

1. Assignments on Newton forward /backward, Lagrange's interpolation.
2.Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule.
3.Assignments on numerical solution of a system of linear equations using Gauss elimination and Gauss-Seidel iterations.
4.Assignments on numerical solution of Algebraic Equation by Regular-falsi and Newton Raphson methods.
5.Assignments on ordinary differential equation: Euler's and Runga-Kutta methods.
6.Introduction to Software Packages: Matlab / Scilab / Labview / Mathematica.

List of MOOCs for 2nd Year Electronics and Communication: Total Credits: 4

Sl. No.	Name of Course	Provider	Duration	Credits	Name of the University/ Institute
1	Programming, Data Structures And Algorithms Using Python	NPTEL	8	3	CMI
2.	An Introduction To Programming Through C++	NPTEL	12	4	IIT, Bombay
3.	Introduction to Internet of Things	NPTEL	12	4	IIT, KGP
4.	Ethical Hacking	NPTEL	12	4	IIT, KGP
5.	Hardware modeling using verilog	NPTEL	8	3	IIT, KGP
6.	Op-Amp Practical Applications: Design, Simulation and Implementation	NPTEL	12	4	IISc, Bangalore
7.	Sensors and Actuators	NPTEL	12	4	IISc, Bangalore
8	Electrical Measurement and Electronic Instruments	NPTEL	12	4	IIT, KGP
9.	Microelectronics: Devices To Circuits	NPTEL	12	4	IIT, Roorkey
10	The Joy of Computing using Python	NPTEL	12	4	IIT, Ropar
11.	Developing Soft Skills and Personality	NPTEL	8	3	IIT, Kanpur
12.	Technical english for engineers	NPTEL	8	3	IIT, Madras
13.	Ethics in Engineering Practice	NPTEL	8	3	IIT, KGP
14	Arduino Programming, from novice to ninja	edX	8	3	Institute Mines Telecom
15	Linux Basics: The Command Line Interface	edX	7	2	Dartmouth College, Institute Mines Telecom
16	Writing, Presenting and Submitting Scientific Papers in English	edX	5	2	Tsinghua University