Study Scheme and Syllabus

B.Tech.

Electronics & Communication Engineering

Batch 2022 & onwards

Department of Electronics & Communication Engineering

Shaheed Bhagat Singh State University, Ferozepur

Shaheed Bhagat Singh State University, Ferozepur
B.Tech. Electronics & Communication Engineering (ECE)
Study Scheme of Semester 3rd and 4th (For Batch 2022 & Onwards)

Semester III [Second year]										
Branch/Course: Electronics and Communication Engineering										
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hrs**	**Internal Marks**	**External Marks**	**Total**	**Credits**
1	BTEC- 301C	Electronic Devices	3	0	0	3	40	60	100	3
2	BTEC- 302C	Digital System Design	3	0	0	3	40	60	100	3
3	BTEC- 303C	Electromagnetic Waves	3	0	0	3	40	60	100	3
4	BTEC-304C	Network Theory	3	1	0	4	40	60	100	4
5	BTAM-301C	Mathematics III	3	1	0	4	40	60	100	4
6	BTEC-305C	Electronic Devices Laboratory	0	0	2	2	30	20	50	1
7	BTEC-306C	Digital System Design Laboratory	0	0	2	2	30	20	50	1
8	BTEC-307C	Circuit Design Techniques-I	0	0	6	6	60	40	100	3
9	BTEC-308C	4-Week Institutional Training	0	0	4	4	60	40	100	2
10	BMPD-301C	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactory	-	-	Non-credit
		Total	**15**	**2**	**16**	**33**	**380**	**420**	**800**	**24**

Semester IV [Second year]										
Branch/Course: Electronics and Communication Engineering										
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hrs**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEC-401C	Analog Circuits	3	0	0	3	40	60	100	3
2	BTEC-402C	Microprocessors and Microcontrollers	3	0	0	3	40	60	100	3
3	BTCS-301C	Data Structures & Algorithms	3	0	0	3	40	60	100	3
4	BTEC-403C	Signals and Systems	3	1	0	4	40	60	100	4
5	BTHU-901C	Personality Development	3	0	0	3	40	60	100	3
6	BTEC-404C	Analog Circuits Laboratory	0	0	2	2	30	20	50	1
7	BTEC-405C	Microprocessors and Microcontrollers Laboratory	0	0	2	2	30	20	50	1
8	BTEC-406C	Circuit Design Techniques-II	0	0	6	6	60	40	100	3
9	BMPD-401C	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactory	-	-	Non-credit
10	*OE-1	OPEN-ELECTIVE	3	0	0	3	40	60	100	3
		Total	**18**	**1**	**12**	**31**	**360**	**440**	**800**	**24**

***The exact Subject Name & Code of the subject to be provided by concerned department**

Semester V [Third year]										
Branch/Course: Electronics and Communication Engineering										
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hrs**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEC-501C	Analog and Digital Communication	3	0	0	3	40	60	100	3
2	BTEC-502C	Linear Integrated Circuits	3	0	0	3	40	60	100	3
3	BTEC-503C	Control Systems	3	0	0	3	40	60	100	3
4	BTEC-xxxC	Department Elective-I	3	0	0	3	40	60	100	3
5	BTHU-902C	Human Resource Management	3	0	0	3	40	60	100	3
6	*OE-II	OPEN ELECTIVE-II	3	0	0	3	40	60	100	3
7	BTEC-504C	Analog and Digital Communication Lab	0	0	2	2	30	20	50	1
8	BTEC-505C	Linear Integrated Circuits Lab	0	0	2	2	30	20	50	1
9	BTEC-506C	Circuit Design Techniques-III Lab	0	0	6	6	60	40	100	3
10	BTEC-507C	Industrial Training**	0	0	4	4	60	40	100	2
11	BMPD-501C	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactor	-	-	Non-credit
		Total	**18**	**0**	**16**	**34**	**420**	**480**	**900**	**25**

**Four to Six weeks Industrial training during Summer Vacations after 4th semester. This must give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome should be presented in the form of a Report. The evaluation is done by Viva-Voce conducted along End-semester exam of fifth semester.

Semester VI [Third Year]										
Branch/Course: Electronics and Communication Engineering										
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hrs**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEC-601C	Wireless Communication	3	0	0	3	40	60	100	3
2	BTEC-602C	Digital Signal Processing	3	1	0	4	40	60	100	4
3	BTEC-603C	Microwave and Antenna Engineering	3	0	0	3	40	60	100	3
4	BTEC-xxxC	Department Elective-II	3	0	0	3	40	60	100	3
5	*OE-III	OPEN ELECTIVE-III	3	0	0	3	40	60	100	3
6	BTEC-604C	Digital Signal Processing Lab	0	0	2	2	30	20	50	1
7	BTEC-605C	Microwave and Antenna Engineering Lab	0	0	2	2	30	20	50	1
8	BTEC-606C	Circuit Design Techniques-IV Lab	0	0	6	6	60	40	100	3
9	BMPD-601C	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactory	-	-	Non-credit
		Total	**15**	**1**	**12**	**28**	**320**	**380**	**700**	**21**

Semester VII [Fourth Year]										
Branch/Course: Electronics and Communication Engineering										
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hrs**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEC-701C	Optical Fibers & Communication	3	0	0	3	40	60	100	3
2	BTEC-702C	VLSI Design	3	0	0	3	40	60	100	3
3	BTEC-703C	Embedded System Design	3	0	0	3	40	60	100	3
4	BTEC-xxxC	Department Elective-III	3	0	0	3	40	60	100	3
5	*OE-IV	OPEN ELECTIVE-IV	3	0	0	3	40	60	100	3
6	BTEC-704C	Optical Fibers & Communication Lab	0	0	2	2	30	20	50	1
7	BTEC-705C	VLSI Design Lab	0	0	2	2	30	20	50	1
8	BTEC-706C	Major Project	0	0	8	8	120	80	200	4
9	BMPD-701C	Mentoring and Professional Development	0	0	2	2	Satisfactory/Un-satisfactory	-	-	Non-credit
		Total	**15**	**0**	**14**	**29**	**380**	**420**	**800**	**21**

Semester VIII [Fourth Year]						
Branch/Course: Electronics and Communication Engineering						
Sr. No.	**Course code**	**Course Title**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEC-801C	Six Months of Industrial Training	300	200	500	14
		Total	**300**	**200**	**500**	**14**

If the students (minimum 8 students) do not opt for semester training, then the students shall be required to study the following:

Semester VIII [Fourth Year]										
Branch/Course: Electronics and Communication Engineering										
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hrs**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEC-802C	Simulation and Modelling Lab (Minor Project & Report)	0	0	4	4	60	40	100	2
2	BTEC-xxxC	Department Elective	3	0	0	3	40	60	100	3
3	BTEC-xxxC	Department Elective	3	0	0	3	40	60	100	3
4	BTEC-xxxC	Department Elective	3	0	0	3	40	60	100	3
5	*OE	OPEN ELECTIVE	3	0	0	3	40	60	100	3
6	BMPD-801C	Mentoring and Professional Development	0	0	2	2	Satisfactory /Un-satisfactory	-	-	Non-credit
		Total	**12**	**0**	**6**	**18**	**220**	**280**	**500**	**14**

Three Department Elective subjects (each of 3 credits) from any of the listed Department Electives (excluding the subjects which the student has opted for earlier).

Department Elective Courses for B.Tech. in ECE (Batch 2022 & onwards)

Department Elective-I (Sem-5)	
Course Code	**Course Title**
BTEC-511C	Internet of Things
BTEC-512C	Information Theory & Coding
BTEC-513C	Python Programming
BTEC-514C	VLSI/ULSI Technology
BTEC-515C	Biomedical Instrumentation
Department Elective-II (Sem-6)	
BTEC-611C	Computer Networks
BTEC-612C	Robotics and Automation
BTEC-613C	Neural Networks and Fuzzy Logic
BTEC-614C	Introduction to Big Data
BTEC-615C	Wireless Sensor Networks
Department Elective-III (Sem-7)	
BTEC-711C	Artificial Intelligence
BTEC-712C	Satellite Communication
BTEC-713C	Java Programming
BTEC-714C	Mobile Computing
BTEC-715C	Deep Learning

Open Elective Courses for B.Tech. in ECE (Batch 2022 & onwards)

The open elective course for the students of B.Tech. ECE will be chosen from the list of open elective courses offered by other departments in every academic session.

List of Open Elective Courses Offered by Department of Electronics and Communication Engineering for Students of Other Programs

SN	Course Code	Course Title	L	T	P	Hours/Week	Credits
1	BTEC-901C	Display Technologies	3	0	0	3	3
2	BTEC-902C	Sensors and Transducers	3	0	0	3	3
3	BTEC-903C	Analog and Digital Communication	3	0	0	3	3
4	BTEC-904C	VLSI Design	3	0	0	3	3
5	BTEC-905C	Mobile Computing	3	0	0	3	3
6	BTEC-906C	Digital Signal Processing	3	0	0	3	3
7	BTEC-907C	Introduction to Big Data	3	0	0	3	3
8	BTEC-908C	Wireless Sensor Networks	3	0	0	3	3
9	BTEC-909C	Internet of Things (IoT)	3	0	0	3	3
10	BTEC-910C	Wireless Communication	3	0	0	3	3
11	BTEC-911C	WLAN and Security	3	0	0	3	3
12	BTEC-912C	Satellite Communication	3	0	0	3	3
13	BTEC-913C	Artificial Intelligence	3	0	0	3	3
14	BTEC-914C	Engineering Materials	3	0	0	3	3
15	BTEC-915C	Artificial Intelligence & Machine Learning	3	0	0	3	3
16	BTEC-916C	Microwave-Photonics	3	0	0	3	3
17	BTEC-917C	Soft Computing	3	0	0	3	3
18	BTEC-918C	Biomedical Instrumentation	3	0	0	3	3
19	BTEC-919C	Robotics and Automation	3	0	0	3	3
20	BTEC-920C	Deep Learning	3	0	0	3	3

THIRD SEMESTER

BTEC-301C	Credits	L	T	P	Int	Ext
Electronic Devices	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to recall concepts of semiconductor physics and understand the behaviour and working of semiconductor devices using mathematical models.

Course Outcomes

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

1. Understand physics of semiconductors and behavior of charge carriers within semiconductors
2. Understand the working of semiconductor diodes supported with mathematical explanation.
3. Understand the working of BJT and MOSFET with their equivalent small signal models.
4. Understand the chemical processes used in fabrication of integrated circuits.

Unit 1: Semiconductor Physics

Review of quantum mechanics; electrons in periodic lattices; e-k diagrams; energy bands in intrinsic and extrinsic silicon; diffusion current; drift current; mobility and resistivity; sheet resistance; design of resistors.

Unit 2: Diodes

Generation and recombination of carriers; Poisson and continuity equation p-n junction characteristics; V-I characteristics; small signal switching models; avalanche breakdown; Zener diode; Schottky diode; light emitting diode; tunnel diode; varactor diode, solar cell, Rectifier & Regulator circuits.

Unit 3: Transistors

Bipolar junction transistor; V-I characteristics; Ebers-Moll model; Transistor Configurations - CE, CB, CC; MOS capacitor; MOSFET - Construction and Working; I-V characteristics; Depletion-type and Enhancement-type MOS.

Unit 4: Fabrication Processes

Oxidation; diffusion; Ion-implantation; Annealing; photolithography; etching; chemical vapour deposition (CVD); sputtering; twin-tub CMOS process.

Recommended Books

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

Note: At least one question must be set from each unit/course outcome.

BTEC-302C	Credits	L	T	P	Int	Ext
Digital System Design	3	3	0	0	40	60

Course Objective

This course deals with fundamental concepts of digital electronics necessary many other courses, like embedded systems, VLSI and computer architecture, etc. to be studied in coming semesters.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Apply concepts of Boolean algebra for handling logical expressions.
2. Understand working and realization of combinational circuits.
3. Understand working flip-flops and use them in designing of sequential circuits.
4. Understand fundamental concepts of logic families and architectural of programmable devices.
5. Use HDL programming tool for simulation of combinational & sequential circuits.

Unit 1: Boolean Algebra & Combinational Circuits

Logic gates; Boolean algebra; De Morgan's theorem, SOP & POS forms, canonical forms, Karnaugh maps up to 6 variables, binary codes, code Conversion, MSI devices like comparators; multiplexers; encoder; decoder; driver & multiplexed display; half and full adders; subtractors; serial and parallel adders; BCD adder; barrel shifter and ALU.

Unit 2: Sequential Circuits

Building blocks of sequential circuits like S-R, J-K,T & D flip-flops; master-slave J-K FF; edge triggered FF; ripple counters; synchronous counters; shift registers; finite state machines; design of synchronous FSM, algorithmic state machines charts; designing synchronous circuits like pulse train generator; pseudo random binary sequence generator; clock generation.

Unit 3: Programmable Devices & ADC and DAC

Specifications: noise margin, propagation delay, fan-in, fan-out, Tristate; TTL, ECL, CMOS families and their interfacing; architectures of PLA, PAL, GAL, CPLD&FPGA. DAC: weighted resistor, R-2R ladder, resistor string; ADC: single slope, dual slope, successive approximation, flash.

Unit 4: Introduction to VHDL

VHDL constructs; Data types and objects; different modelling styles in VHDL; Dataflow, Behavioural and Structural Modelling; Synthesis and Simulation; HDL programming for basic combinational and sequential circuits.

Recommended Books

1. R.P. Jain, *Modern digital Electronics*, Tata McGraw Hill
2. Douglas Perry, *VHDL*, Tata McGraw Hill
3. W.H. Gothmann, *Digital Electronics-An introduction to theory and practice*, PHI
4. D.V. Hall, *Digital Circuits and Systems*, Tata McGraw Hill
5. Charles Roth, *Digital System Design using VHDL*, Tata McGraw Hill

Note: At least one question must be set from each unit/course outcome.

BTEC-303C	Credits	L	T	P	Int	Ext
Electromagnetic Waves	3	3	0	0	40	60

Course Objective

This course deals with knowledge and background required for better understanding of Electromagnetic Waves and fundamentals.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand characteristics & wave propagation through transmission lines
2. Understand Maxwell's equations for electromagnetic waves
3. Characterize uniform plane wave
4. Calculate reflection and transmission of waves at media interface

Unit 1: Transmission Lines

Equations of voltage and current on transmission line; propagation constant and characteristic impedance, and reflection coefficient and VSWR; Loss-less and Low-loss transmission line; Power transfer on transmission line; S-parameters, Smith chart; applications of transmission lines; impedance matching; use of transmission line sections as circuit elements.

Unit 2: Maxwell's Equations

Basics of vectors; Vector calculus; Basic laws of Electromagnetic; Maxwell's equations; Boundary conditions at media Interface.

Unit 3: Uniform Plane Wave

Uniform plane wave; propagation of wave; wave polarization; Poincare's sphere; wave propagation in conducting medium; phase and group velocity; power flow and Poynting vector; surface current and power loss in a conductor.

Unit 4: Plane Waves at a Media Interface

Plane wave in arbitrary direction; reflection and refraction at dielectric interface; total internal reflection; wave polarization at media interface; reflection from a conducting boundary.

Unit 5: Wave propagation in parallel plane waveguide

Analysis of waveguide general approach; rectangular waveguide, modal propagation in rectangular waveguide; surface currents on the waveguide walls, field visualization, attenuation in waveguide.

Recommended Books

1. RK Shevgaonkar, *Electromagnetic Waves*, Tata McGraw Hill India
2. EC Jordan & KG Balmain, *Electromagnetic waves & Radiating Systems*, PHI
3. N Rao,*Engineering Electromagnetics*, Prentice Hall
4. DCheng, *Electromagnetics*, Prentice Hall
5. W H Hayt & J A Buck,*Engineering Electromagnetics*, McGraw Hill

Note: At least one question must be set from each unit/course outcome.

BTEC-304C	Credits	L	T	P	Int	Ext
Network Theory	4	3	1	0	40	60

Course Objective

This course is meant to create mathematical foundation which can further be extrapolated to understand and analyze the electrical networks.

Course Outcomes

At the end of this course student will be able to:

1. Analyze linear networks using network theorems.
2. Use Laplace transform to analyze transient & steady state response of linear networks.
3. Comprehend network parameters to analyze two port networks.
4. Realize one port networks using Foster's and Cauer's methods.

Unit 1: Network Theorems

Node and mesh analysis; impedance matrix approach for networks analysis; Network theorems: superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC circuits; Trigonometric and Exponential Fourier series, Fourier Transform and continuous spectra Three phase unbalanced circuit and power calculation.

Unit 2: Transient & Steady State Analysis

Transient behavior, concept of complex frequency, Driving points, Poles and Zeros, Laplace transforms and properties: singularity functions, waveform synthesis; time domain analysis of RC, RL & RLC networks with and without initial conditions; Laplace Transforms for steady state and transient response of networks, quality factor.

Unit 3: Two Port Networks

Impedance parameters; admittance parameters; transmission parameters; hybrid parameters; inter-relationships between two port network parameters; interconnection of two port networks; T and Pi representation of two port networks; image impedance; characteristic impedance; propagation constant; filters: low pass, high pass; band pass, band stop & Butterworth filter.

Unit 4: Network Synthesis

Realizability criteria: Hurwitz polynomial, positive real functions; network realization using

Foster's first and second forms; network synthesis using Cauer's first and second forms.

Recommended Books

1. Van, Valkenburg, *Network Analysis*, PHI
2. F F Kuo, *Network Analysis & Synthesis*, Wiley
3. A. Sudhakar, SP Shyammohan, *Circuits and Network*, Tata McGraw-Hill
4. A William Hayt, *Engineering Circuit Analysis*, McGraw-Hill Education

Note: At least one question must be set from each unit/course outcome.

BTAM-301C	Credits	L	T	P	Int	Ext
Mathematics III	4	3	1	0	40	60

Course Objective

The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables along with Probability and Correlation. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Outcomes

The students will learn:

1. The mathematical tools needed in evaluating multiple integrals and their usage.
2. The effective mathematical tools for the solutions of differential equations that model physical processes.
3. The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.
4. To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
5. To provide an overview of probability and statistics to engineers

Section A

Unit 1 : Transforms Calculus-I:

Laplace Transform, Properties of Laplace Transform, Laplace Transform of Unit step function, Impulse function, Dirac-delta function, Periodic functions. Inverse Laplace Transform, convolution theorem, Evaluation of integrals by Laplace Transform, Applications to ODEs and PDEs.

Unit 2: Transforms Calculus-II:

Fourier Series, half range Fourier Sine and Cosine series, Fourier integrals, Gibbs Phenomenon, Fourier transforms, Relation between Laplace and Fourier transform, Properties of Fourier Transforms, Convolution Theorem and applications

Unit 3: Transforms Calculus-III

Basic theory of Z transforms, Translation theorem, Scaling property of Z transforms, Initial and Final value theorems, Differentiation of Z tranforms Solution of Difference equations using Z transform, Applications of Z transforms to find the sum of series

Section B

Unit 4: Probability

Conditional probability, Discrete and continuous random variables, Probability distributions: Binomial, Poisson and Normal, Poisson approximation to the binomial distribution, evaluation of statistical parameters for these three distributions.

Unit 5: Correlation and regression

Correlation and Regression for bivariate data, Rank correlation, Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas and more general curves. Test of significance for small and large samples (z-test, t-test, F-test and Chi-square test).

Text / Reference Books:

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
2. R K jain and Iyengar, "Advanced Engineering Mathematics", 5th Edition, Narosa Publishing, 2017.
3. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
4. S. Ross, "A First Course in Probability", Pearson Education India, 2002.
5. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 1968.

Note: At least one question must be set from each unit/course outcome.

BTEC-305C	Credits	L	T	P	Int	Ext
Electronic Devices Lab	1	0	0	2	30	20

Course Objective

This is basic course meant to give hands on experience of semiconductor devices and making them to use in circuits & projects.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Realize use of diodes in circuits with proper understanding to their working.
2. Understand characteristics & working of BJT in different configurations.
3. Understand characteristics & working of MOSFET in circuits.
4. Think and design working circuits based on diodes, BJTs and MOSFETs.

Part-A: Experiments

List of Experiments

1. To Study of datasheets of semiconductor devices.
2. To study the V-I characteristics of PN junction diode.
3. To study a Zener diode as voltage regulator.
4. To study the output waveform of a Half-wave rectifier.
5. To study the functioning of a Diode as a switch.
6. To study the output waveform of a Full-wave center-tapped and bridge rectifier.
7. To study Input & output V-I characteristics of npn/pnp BJT in CE configuration
8. To study Input & output V-I characteristics of npn/pnp BJT in CB configuration
9. To study the functioning of a BJT as a switch.
10. To study V-I Characteristics of a MOSFET.

Part-B: Lab Projects

Every individual student is required design and build one Lab Project under the supervision of course teacher. Topic of the project may be any from the theory contents and not limited to following list:

1. Blinking linear/circular lights
2. Ambient light sensor based controller
3. Regulated dual power supply of ±5V or ±12V or mixed
4. BJT audio amplifier
5. BJT circuit for sampling of analog signal
6. Simulate any project idea using SPICE software

BTEC-306C	Credits	L	T	P	Int	Ext
Digital System Design Lab	1	0	0	2	30	20

Course Objective

This is laboratory course meant to realize basic digital circuits using physical components and EDA tools in simulation environment.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Realize combinational circuits using logic gates.
2. Realize sequential circuits using logic gates.
3. Write & simulate VHDL programs for combinational & sequential circuits.
4. Think and design working projects using digital 74XX ICs.

Part-A: Experiments (Any 10 Experiments)

1. To verify the Truth-tables of all logic gates.
2. To realize and verify the Half & full adder circuits using logic gates.
3. To realize Half & full subtractor circuits using logic gates.
4. To realize 4-bit binary-gray & gray-binary converters.
5. To realize comparator circuit for two binary numbers of 2-bit each.
6. To realize Full adder & full subtractor circuits using 8x3 encoder.
7. To design Full adder & full subtractor circuits using 8x3 demultiplexer.
8. To design and verify the Truth tables of all flip-flops.
9. To design Mod-6/Mod-9 synchronous up-down counter.
10. To write VHDL program for combinational & sequential circuits from S. No. 2 to 7
11. To write VHDL program for universal shift-register operations

Part-B: Lab Projects

Every individual student is required design one Lab Project under the supervision of course teacher. Topic of the project may be any from the theory contents and not limited to following list:

1. Pulse Width Modulator based LED dimmer using 555 timer IC.
2. Up-down 4-bit counter with seven-segment display.
3. Construction of combinational circuits using universal gates.
4. Bi-directional visitors counter
5. Traffic light control system
6. Any project based on Arduino platform

BTEC-307C	Credits	L	T	P	Int	Ext
Circuit Design Techniques-I	3	0	0	6	60	40

Course Objective

This is laboratory course meant to enable students to learn the basics of digital and analog circuit design techniques in the simulation environment

Course Outcomes

At the end of this course student will demonstrate the ability in the following:

1. Familiarity with electronics circuit design and simulation environment in MultiSim
2. The design and simulation of analog circuits
3. The design and simulation of digital circuits
4. Familiarity with Spice Simulation and Design Environment

List of Experiments

1. Introduction of MultiSim Environment, Design Process and Setting of the environment preferences.
2. Understanding of Multisim Graphical User Interface.
3. Introduction of Schematic capture of circuits: Placing components and Wiring of components.
4. Introduction of Circuit simulation using basic circuits, reading voltage and currents in the circuit, and displaying waveforms in MultiSim.
5. Study of basic circuit laws: Ohm's Law, Kirchoff's laws with the help of experimentation on design of resistances based voltage divider circuit.
6. Design and simulation of voltage regulator using Zener Diode
7. Introduction of SPICE (Simulation Program with Integrated Circuit Emphasis) and Circuit modeling using spice: Overview of Spice Simulation and Design Environment.
8. SPICE based simulator analysis and study its use in real time applications.
9. Design of digital circuits in multisim: Verify the Truth-tables of all logic gates.
10. Design and simulation of digital multiplexer circuit.
11. Design and simulation of two input comparator circuit.
12. Design and simulation of flip-flops based circuits.

BTEC-308C	Credits	L	T	P	Int	Ext
4-Week Institutional Training	2	0	0	4	60	40

Four weeks training in the area of Electronics and Communication Engineering. This training should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her.

BMPD-301C	Credits	L	T	P	Int	Ext
Mentoring and Professional Development*	Non-credit	0	0	2	S/US**	

* Guidelines regarding evaluation and rubrics of subject Mentoring and Professional Development as per MoM no. 4403 dated 23.10.19

**S/US - Satisfactory and Unsatisfactory

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A

(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B

(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B

Mentors/Faculty incharges shall maintain proper record of students for each activity conducted and the same shall be submitted to the department.

FOURTH SEMESTER

BTEC-401C	Credits	L	T	P	Int	Ext
Analog Circuits	3	3	0	0	40	60

Course Objective

This course deals design & analytical concepts of various Analog circuits like BJT/FET circuits, feedback amplifiers, oscillators, power amplifiers.

Course Outcomes

At the end of this course student will be able to:

1. Understand the biasing of transistors and analyze BJT/FET amplifiers
2. Analyze various rectifier and amplifier circuits
3. Analyze sinusoidal and non-sinusoidal oscillators
4. Understand various types of Power Amplifiers

Unit 1: Diode and Transistor Amplifier Circuits

Diode Circuits, Amplifiers types: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier; biasing schemes for BJT and FET amplifiers; bias stability; transistor configurations: CE/CS, CB/CG, CC/CD and their features; small-signal analysis; low-frequency transistor models; amplifier analysis: current gain, voltage gain, input resistance and output resistance; amplifier design procedure; low frequency analysis of multistage amplifiers. High frequency transistor models.

Unit 2: Feedback Amplifiers

Feedback topologies: Voltage series, current series, voltage shunt and current shunt feedback; effect of feedback on gain, bandwidth, input & output impedances; concept of stability, gain margin and phase margin.

Unit 3: Oscillators Introduction, Types of Oscillators, Barkhausen criterion, RC-phase shift, Wien bridge, Hartley, Colpitts, Clapp oscillators and Non-sinusoidal oscillators.

Unit 4: Power Amplifiers

Class A, B, AB and C power amplifiers, their efficiency and distortions; frequency response: single stage, multistage amplifiers and cascade amplifier.

Recommended Books

1. J Millman & A Grabel, *Microelectronics*, McGraw Hill
2. J Millman& C Halkias, *Integrated Electronics*, Tata McGraw Hill
3. A Ramakant, Gayakwad, *Op-Amps And Linear Integrated Circuits*, PHI
4. P Horowitz & W Hill, *The Art of Electronics*, Cambridge University Press
5. AS Sedra & KC Smith, *Microelectronic Circuits*, Saunder's College Publishing

Note: At least one question must be set from each unit/course outcome.

BTEC-402C	Credits	L	T	P	Int	Ext
Microprocessors and Microcontrollers	3	3	0	0	40	60

Course Objective

This is course deals with fundamental concepts of digital electronics necessary many other courses, like embedded systems, VLSI and computer architecture, etc. to be studied in coming semesters.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Understand architecture &functionalities of different building block of 8085 microprocessor.
2. Understand working of different building blocks of 8051 microcontroller.
3. Comprehend and apply programming aspects of 8051 microcontroller.
4. Interface & interact with different peripherals and devices.

Unit 1: Microprocessor 8085

History of microprocessors; microprocessor 8085 Architecture, Pin configuration; Memory Interfacing; microprocessor programming model; 8085 instructions; Addressing modes; programming techniques, counters and time delays; stack and subroutines; interrupts.

Unit 2: Microcontroller 8051 - Building Blocks

Microprocessor vs microcontroller; RISC vs CISC architectures; microcontroller 8051: architecture, pin configuration, flag-bits and PSW register, input-output ports, register banks and stack; semiconductor memories: ROM, SRAM, DRAM, virtual memory, cache memory; memory organization.

Unit 3: Microcontroller 8051 - Programming

Assembly language programming; data types and directives; jump loop and call instructions; I/O port programming; addressing modes and accessing memory using various addressing modes; arithmetic instructions and programs; logic instructions and programs; single bit instructions and programming, 8051 interrupts; timer/counter programming in the 8051.

Unit 4: Microcontroller 8051 - Interfacing

Parallel and serial ADC& DAC interfacing; LCD interfacing, Keyboard interfacing; sensor interfacing; interfacing with external memory; matrix keypad; stepper motor interfacing; DC motor interfacing and PWM.

Recommended Books

1. R S Gaonkar, *Microprocessor Architecture, Programming and Application with 8085*, Penram International Publishing Pvt. Ltd.
2. Kenneth Ayala, *The 8051 Microcontroller*, Cengage Learning
3. Douglas Hall, *Microprocessors Interfacing*, Tata McGraw Hill
4. Subrata Ghoshal, *8051 Microcontroller: Internals, Instructions, Programming and Interfacing*, Pearson Education
5. K Uma Rao, Andhe Pallavi, *The 8051 Microcontrollers: Architecture, Programming and Applications*, Pearson Education.

Note: At least one question must be set from each unit/course outcome.

BTCS-301C	Credits	L	T	P	Int	Ext
Data Structures and Algorithms	3	3	0	0	40	60

Course Objective

The objective of the course is to impart the basic concepts of data structures and algorithms, to understand concepts about searching and sorting technique and to understand basic concepts about stacks, queues, lists, trees and graphs, data structures.

Course Outcomes

Student will be able to:

1. Understand operations like searching, insertion, deletion, traversing on linear Data Structures and to determine their computational complexities
2. Understand operations like searching, insertion, deletion, traversing on various non linear Data Structures and to determine their computational complexities
3. Write algorithms for Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
4. Apply appropriate Data Structure as per specific problem definition

Module 1

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. Introduction to pointers and dynamic memory allocation, use of pointers in self referential data structures.

Module 2

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

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.

Module 4

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.

Recommended Books

1. "Classic Data Stuructures", Samanta and Debasis, PHI publishers
2. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.
3. "Data Structures with C (Schaum's Outline Series)",Seymour Lipschutz,Mc Graw Hill.
4. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
5. "How to Solve it by Computer" , 2nd Impression by R. G. Dromey, Pearson Education.
6. Algorithms by Tannenbaum

Note: At least one question must be set from each unit/course outcome.

BTEC-403C	Credits	L	T	P	Int	Ext
Signals & Systems	4	3	1	0	40	60

Course Objective: The objective of this course is to enable students to apply mathematical concepts and tool in analysis of electrical signals and systems.

Course Outcomes:

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

1. Mathematically characterize different types of signals and systems.
2. Analyze the behavior of linear-shift invariant systems.
3. Apply concepts of Fourier and Laplace Transforms to analyze continuous-time signals and systems.
4. Investigate discrete-time signals and systems using Discrete-Time Fourier and Z-Transforms and simple Probability concepts.

Unit 1: Introduction to Signals and Systems

Classification of Signals: Periodic and Aperiodic signals, continuous and discrete time signals, continuous and discrete amplitude signals; Linear and nonlinear signals, Causal and non-causal signals, Even and odd signals, Energy and power signals; System properties: linearity, shift-invariance ,causality, stability, Realizability.

Unit 2: Linear-Shift Invariant Systems

Linear shift-invariant systems; Impulse response and step response ;Convolution, Input-output behaviour with Aperiodic convergent inputs; Characterization of causality and stability of LSI systems; System representation through differential equations and difference equations; Periodic inputs to an LSI system; Notion of frequency response and its relation to the impulse response.

Unit 3: Continuous-Time Analysis of Signals and Systems

Fourier Series; Fourier Transform; Magnitude and phase response; Properties of Fourier Transform: Convolution/Multiplication, Duality, Time-shifting, Frequency-shifting, Time-scaling, Integration and differentiation in time-domain; Review of Laplace Transform for continuous-time signals and systems; Notion of Eigen functions of LSI systems; System transfer function and poles-zeros analysis; Solution to differential equations and system behaviour.

Unit 4: Discrete-Time Analysis of Signals and Systems

Sampling Theorem and its proof; Spectra of sampled signals; Aliasing and its effects; Reconstruction and its implications; Probability: Mean, median, mode and standard deviation; combinatorial probability, probability distribution functions. Discrete-Time Fourier Transform (DTFT); Discrete Fourier Transform; Parseval's Theorem; Review of Z-Transform for discrete-time signals and systems; System functions; Region of convergence and z-domain analysis, Conditional Probability.

Text/Reference books:

1. Allan V. Oppenheim, S. Wilsky and S. H. Nawab, *Signals and Systems*, Pearson Education
2. I J Nagrath, S N Sharan, R Ranjan S Kumar, *Signals and Systems*, Tata McGraw Hill
3. B.P. Lathi, Signal Processing and Linear Systems, Oxford University Press
4. S Poornachandra, B Sasikala, *Signals and Systems*, Tata McGraw Hill
5. Robert A. Gabel, Richard A. Roberts, *Signals and Linear Systems*, John Wiley and Sons.

Note: At least one question must be set from each unit/course outcome.

BTHU-901C	Credits	L	T	P	Int	Ext
Personality Developement	3	3	0	0	40	60

Syllabus attached at the end as provided by DASH department

BTEC-404C	Credits	L	T	P	Int	Ext
Analog Circuits Laboratory	1	0	0	2	30	20

Course Objective

This laboratory course deals design & analytical concepts of various analog circuits like BJT/FET circuits, feedback amplifiers, oscillators, power amplifiers.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. study and verify the characteristics of diodes/BJTs in circuits with proper understanding to their working.
2. Understand frequency response & working of various types of Oscillators.
3. Understand characteristics & working of Power amplifiers.
4. Think and design working circuits based on diodes, BJTs and MOSFETs.

Part-A: Experiments

List of Experiments:

1.To Study the Output waveforms of diode clipper and Diode Clamper circuits.

2.To study BJT amplifier in CE configuration.

3. To study V-I Characteristics of FET/MOSFET.

3.To study Emitter follower circuit.

4. To calculate the frequency and observe the output waveform of RC phase shift oscillator.

5.To measure the frequency and observe the output waveform of Wein bridge oscillator.

6. To measure the frequency and observe the output waveform of Hartley oscillator.

7. To measure the frequency and observe the output waveform of Colpitt's oscillator.

8. To study Output waveform of Class-A Power Amplifier.

9. To study Output waveform of Class-B Power Amplifier.

Part-B: Lab Projects

Every individual student is required design one Lab Project under the supervision of course teacher. Topic of the project may be any from the theory contents and not limited to following list:

1. BJT audio amplifier/power amplifier
2. Any project based on IoT/Arduino platform

BTEC-405C	Credits	L	T	P	Int	Ext
Microprocessors and Microcontrollers Laboratory	1	0	0	2	30	20

Course Objective

This is laboratory course meant to write programs using 8085/8086 microprocessor and learn interfacing using 8051 microcontoller for general operations.

Course Outcomes

At the end of this Lab course student will be able to:

1. Write programs for common arithmetic operations with 8-bit/16-bit numbers using 8085.
2. Write programs for transfer, sort block of data with 8085/8086 processor(s).
3. Write programs for controlling stepper and DC motors using Microprocessor(s).
4. Write programs to generate waveforms and interface ADC and DAC using of 8051 Microcontroller.

Part-A: Write programs in Assembly language & embedded C to

1. Add two 8-bit numbers stored in registers or internal/External memory locations.
2. Multiply two 8-bit numbers.
3. Multiply two 16-bit numbers.
4. Transfer block of data from internal memory locations to external memory locations
5. Sort block of data in ascending or descending order.
6. Generate 5KHz pulse waveform of 50% duty cycle.
7. Interface ADC and DAC.
8. Interface Matrix Keyboard.
9. Interface LCD Displays.
10. Interface Stepper Motor.
11. Control DC motor using PWM.

Part-B: Lab Projects

Every individual student is required design one Lab Project under the supervision of course teacher. Topic of the project may be any from the theory contents and not limited to following list:

1. RFID attendance system
2. Home automation
3. Robotic vehicle
4. Sensor traffic lights
5. Floor cleaning robot
6. Robot for defense applications
7. GPS vehicle tracking
8. Accident identification and SMS

BTEC-406C	Credits	L	T	P	Int	Ext
Circuit Design Techniques-II	3	0	0	6	60	40

Course Objective

This is laboratory course meant to enable students to learn in depth the design and simulation of analog and digital circuits in the simulation environment

Course Outcomes

At the end of this course student will demonstrate the ability in the following:

1. Study of Diode V-I characteristics and diodes based circuits
2. Study of Transistor V-I characteristics and transistors based circuits
3. Study of FET/MOSFET V-I characteristics and FET/MOSFET based circuits
4. The design and simulation of digital arithmetic circuits

List of Experiments

1. To Study the V-I characteristics of diode in forward biasing and reverse biasing.
2. To study the input & output V-I characteristics of npn/pnp Transistor in Common Emitter and Common Base configurations
3. To study V-I Characteristics of FET/MOSFET
4. Design and simulation of Half-Wave & Full Wave rectifier circuits.
5. Design and simulation of class A, B and C amplifiers
6. Design and simulation of oscillator circuits
7. Design and simulation of Half Adder circuit.
8. Design and simulation of Full Adder circuit.
9. Design and simulation of Half Subtractor circuit.
10. Design and simulation of Full Subtractor circuit.
11. Design and simulation of Digital counter circuits.
12. Design and simulation of circuit for functioning of a BJT/MOSFET as a switch.

BMPD-401C	Credits	L	T	P	Int	Ext
Mentoring and Professional Development*	Non-credit	0	0	2	S/US**	

* Guidelines regarding evaluation and rubrics of subject Mentoring and Professional Development as per MoM no. 4403 dated 23.10.19

**S/US - Satisfactory and Unsatisfactory

* Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A

(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B

(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B

Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

5th Semester

BTEC-501C	Credits	L	T	P	Int	Ext
Analog and Digital Communication	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to know the concepts of Analog as well as Digital Communication and understand the working of common communication techniques.

Course Outcomes

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

1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth
2. Analyze the behavior of a communication system in presence of noise
3. Investigate pulsed modulation system and analyze their system performance
4. Analyze different digital modulation schemes and can compute the bit error performance

Unit 1: Analog Communication

Review of Signals and Systems, Frequency domain representation of signals, Amplitude Modulation: Transmission and Reception of DSB, SSB and VSB, Angle Modulation, Spectral characteristics of angle modulated signals, Principles of Frequency and Pulse Modulation, Representation of FM and PM signals, Review of white noise characteristics, Noise in amplitude modulation and Angle Modulation systems, Pre-emphasis and De-emphasis.

Unit 2: Digital Communication

Analog to Digital: Need, Sampling process, Pulse Amplitude modulation and Concept of Time division multiplexing, Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation and demodulation, Adaptive and Sigma Delta Modulation, Noise considerations in PCM, Digital Multiplexers.

Unit 3: Elements of Detection Theory

Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Review of probability and random process Gaussian noise characteristics, Baseband Pulse Transmission: Inter symbol Interference and Nyquist criterion.

Unit 4: Digital Modulation Techniques

Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Recommended Books

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering'',John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication'', Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications'', 4th Edition, McGraw Hill, 2000.

Note: At least one question must be set from each unit/course outcome.

BTEC-502C	Credits	L	T	P	Int	Ext
Linear Integrated Circuits	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to know the concepts of Linear Integrated Circuits and their working along with their applications.

Course Outcomes

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

1. Understand Differential and Cascade Amplifiers
2. Know the basics, working and characteristics of Op-Amps
3. Investigate various applications of Op-amps
4. Understand some specialized Op-Amps
5. Interpretation of Data Sheets and their Applications thereof.

Unit I: Differential and Cascade Amplifiers

Introduction: Differential Amplifier, its Circuit Configuration, Dual Input-Balanced output Differential amplifier, Dual Input Unbalanced output, Single Input Balanced & Unbalanced Output Differential Amplifier, Amplifier with their DC and AC analysis, Differential Amplifier with Swaping resistors, Constant current bias, Current Mirror, Cascaded differential amplifier stages, Level Translator, CE-CB Configuration.

Unit II: Introduction to Operational Amplifiers

Block diagram of a typical Op-Amp, Schematic symbol, integrated circuits and their types, IC package types, Pin Identification and temperature range, Interpretation of Data sheets, Overview of typical set of data sheets, Characteristics and performance parameters of and Op-Amp, Ideal Op-Amp, Equivalent circuit of an Op-Amp, Ideal voltage transfer curve, Open loop configurations: Differential, Inverting & Non Inverting. Practical Op-Amp: Input offset voltage, Input bias current, Input offset current, total output offset voltage, Thermal drift, Effect of variation in power supply voltages on offset voltage, Temperature and supply voltage sensitive parameters, Noise, Common Mode configuration and common mode rejection Ratio. Feedback configurations.

Unit III: Applications of Op-Amp

DC and AC amplifiers, Peaking Amp, Summing, Scaling and Averaging Amp, Instrumentation Amplifier, Log and Antilog Amp, Integrator, Differentiator. Active filters: First order LP Butterworth filter, Second order LP Butterworth filter, First order HP Butterworth filter, Second-order HP Butterworth filter, Higher order filters, Band Pass filter, Band reject Filter, All Pass filter, Phase shift Oscillator, Wein Bridge Oscillator, Square wave Oscillator, Basic Comparator, Schmitt trigger, V to F and F to V converters.

Unit IV: Specialized IC Applications

IC 555 Timer: Pin configuration, Block diagram, application of IC 555 as Monostable and Astable Multivibrator., Phase Lock Loops: Operating principles & applications of IC 565 and IC 566, Monolithic PLL TL082, Voltage Regulators: Fixed voltage regulators (78XX and 79XX), Adjustable voltage regulators (LM327), Analog multiplier ICs (MPY634 KP) and their applications, Switching Regulators, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC.

Recommended Books

1. Op Amps & Linear Integrated circuits by Ramakant A. Gayakwad, Pearson
2. Operational Amplifiers & Linear Integrated circuits by Robert F. Coughlin, Prentice Hall
3. Design with Operational Amplifiers and Analog Integrated Circuits, Sergio Franco, TMH

BTEC-503C	Credits	L	T	P	Int	Ext
Control Systems	3	3	0	0	40	60

Course Objective

This is the course meant to gain the knowledge of important control systems, characterize them and study their state behaviour.

Course Outcomes

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

1. Characterize a system and find its study state behaviour
2. Investigate stability of a system using different tests
3. Design various controllers
4. Solve linear, non-linear and optimal control problems

Unit 1: Introduction

Classification with understanding of Industrial Control system examples. Transfer function. System with dead-time. System response. Control hardware and their models: potentiometers, synchros, LVDT, DC and AC servomotors, Tacho generators, Electro hydraulic valves, hydraulic servomotors, electro pneumatic valves, pneumatic actuators. Closed-loop systems. Block diagram and signal flow graph analysis.

Unit 2: Feedback Control systems

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness. proportional, integral and derivative systems. Feed forward and multi-loop control configurations, stability concept, relative stability, Routh stability criterion.

Unit 3: Second Order systems

Time response of second-order systems, steady-state errors and error constants. Performance specifications in time-domain. Root locus method of design. Lead and lag compensation.

Frequency-response analysis- Polar plots, Bode plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Performance specifications in frequency-domain. Frequency domain methods of design, Compensation & their realization in time & frequency domain. Lead and Lag compensation. Op-amp based and digital implementation of compensators. Tuning of process controllers. State variable formulation and solution.

Unit 4: State variable Analysis

Concepts of state, state variable, state model, state models for linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability. Introduction to Optimal control & Nonlinear control, Optimal Control problem, Regulator problem, Output regulator, tracking problem. Nonlinear system – Basic concept & analysis.

Recommended Books:

1. Gopal. M., “Control Systems: Principles and Design”, Tata McGraw-Hill, 1997.
2. Kuo, B.C., “Automatic Control System”, Prentice Hall, sixth edition, 1993.
3. Ogata, K., “ Modern Control Engineering” , Prentice Hall, second edition, 1991.
4. Nagrath& Gopal, “Modern Control Engineering”, New Age International, New Delhi.

Department Electives of 5th Semester (Department Elective-I)

BTEC-511C	Credits	L	T	P	Int	Ext
Internet of Things	3	3	0	0	40	60

Course Objective:

This course will enable the students to understand the concepts of IoT technology, its hardware and software constituents, various design and development issues.

Course Outcomes:

After undergoing this course students will be able to

I. Understand basics of IoT Technology and its applications in various domains.
II. Have knowledge of IoT Hardware, devices and architectural designs.
III. Have understanding of the IoT softwares, programming frameworks and development techniques.
IV. Learn about Security, interoperability issues, challenges, solutions and vision of the IoT with supporting technologies.

Unit 1: Basics of IoT Technology and its Applications

Introduction and History of IoT, Basic building blocks of IoT, Functional blocks, Standards considerations, Applications: Home automation, Industry applications, Surveillance applications, Other IoT applications, Overview of communication and networking technologies in IoT.

Unit 2: IoT Hardware and Architecture

IoT architecture outline, Physical and logical design of IoT, Service Oriented Architecture, API Oriented Architecture, IoT Sensors, Wearable Electronics, Standard Devices, IoT Actuators, IoT Resource Management, Data Management and Analytics.

Unit 3: Software and Development Techniques for IoTs

Introduction to IoT Programming frameworks, IoT development using Python programming environment, Introduction to various IoT tools, Techniques for development of applications through IoT tools, Development of sensor based application through embedded system platforms, Implementing IoT concepts using Python.

Unit 4: Security and Interoperability

IoT reliability, security and privacy issues, Understanding the risks, Modes of attack, Identity protection, Tools for achieving security, Interoperability and its need.

Unit 5: IoT Challenges and Vision

Design challenges, Development challenges, Other challenges and solutions for IoT, Vision of IoT, Introduction and use of supporting technologies in IoT: Cloud computing, FOG computing, Virtualization on embedded boards, Micro virtual machines (MicroVMs), Cloud-assisted cyber-physical systems (CPS).

Recommended Text and Reference Books

1. R K Buyya, V Dastjerdi, Internet of Things, Principles and Paradigms, Morgan Kaufmann Imprint of Elsevier.
2. P Vaher, Learning Internet of Things, PACKT Publishing.
3. O Vermesan, P Friess, Internet of Things- From Research and Innovation to Market Deployment, River Publishers.
4. Vijay Madisetti, Arshdeep Bahga, Internet of Things: A Hands-On Approach, Universities Press.
5. W Dargie, C Poellabauer, Fundamentals of Wireless Sensor Networks: Theory and Practice, John Wiley & Sons.

Note: At least one question must be set from each unit/course outcome.

BTEC-512C	Credits	L	T	P	Int	Ext
Information Theory and Coding	3	3	0	0	40	60

Course Objectives

This course deals with knowledge and importance with understanding of Information Theory and Coding along with coding techniques.

Course Outcomes

At the end of this course students will demonstrate the ability to:
1. Understand the concept of information and entropy
2. Understand Shannon's theorem for coding
3. Calculation of channel capacity
4. Apply coding techniques

Unit 1 – Basic Concepts of Information Theory: The concept of Amount of Information, Average Information, Entropy, Information rate, Shannon's Theorem, Mutual information; Channel capacity; BSC and other channels, Capacity of a Gaussian Channel, Bandwidth - S/N Trade-off, Introduction to Channel Capacity & Coding, Channel Models, Channel Capacity Theorem, Shannon Limit. Huffman source coding algorithm, Lempel Ziv source coding algorithm.

Unit 2 - Introduction to Error Control Coding: Linear Block Codes: Introduction to Linear Block codes, Syndrome and Error detection, Minimum distance of block code, Hamming Code. Cyclic Codes: Description of Cyclic codes, Generator and parity check matrices of cyclic codes, error detection decoding of cyclic codes. BCH Codes: Description of codes, Decoding of BCH codes, Implementation of error connection.

Unit 3 - Convolution Codes: Encoding of convolution codes, structural properties of Convolution codes, Distance Properties of convolution codes. Automatic Repeat Request Strategies: Stop and wait, Go back and selective repeat ARQ strategies, Hybrid ARQ Schemes.

Unit 4- Error Control Coding: Concatenated Codes and Turbo Codes, Single level Concatenated codes, Multilevel Concatenated codes, Soft decision Multistage decoding, Concatenated coding schemes with Convolutional Inner codes, Introduction to Turbo coding and their distance properties, Design of Turbo codes.

Text/Reference Books:

- 1. N. Abramson, Information and Coding, McGraw Hill, 1963.
- 2. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
- 3. R.B. Ash, Information Theory, Prentice Hall, 1970.
- 4. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.
- Ranjan Bose, Information Theory, Coding and Cryptography, The McGraw Hill, 2007.
- Related IEEE/IEE Publications

BTEC-513C	Credits	L	T	P	Int	Ext
Python Programming	3	3	0	0	40	60

Course Objective

The main objective of this course is to enlighten the students with the basic fundamentals of Python programming, its functions & the concept of Eratosthenes.

Course Outcomes

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

1. Read and write simple Python programs.
2. Develop Python programs with conditionals and loops.
3. Define Python functions and to use Python data structures–lists, tuples, dictionaries.
4. Perform input/output operations with files in Python.
5. Execute Searching, sorting and merging in Python.

Unit I: Introduction - The Programming Cycle for Python, Python IDE, Interacting with Python Programs, Elements of Python, Type Conversion. Basics: Expressions, Assignment Statement, Arithmetic Operators, Operator Precedence, Boolean Expression.

Unit 2: Functions - Parts of A Function, Execution of A Function, Keyword and Default Arguments, Scope Rules. String: Length of the string and perform Concatenation and Repeat operations in it. Indexing and Slicing of Strings. Python Data Structure: Tuples, Unpacking Sequences, Lists, Mutable Sequences, List Comprehension, Sets, Dictionaries Higher Order Functions: Treat functions as first class Objects, Lambda Expressions.

Unit 3: Sieve of Eratosthenes - Generate prime numbers with the help of an algorithm given by the Greek Mathematician named Eratosthenes, whose algorithm is known as Sieve of Eratosthenes. File I/O: File input and output operations in Python Programming Exceptions and Assertions

Unit 4: Modules and Classes - Modules: Introduction, Importing Modules, Abstract Data Types: Abstract data types and ADT interface in Python Programming. Classes: Class definition and other operations in the classes, Special Methods (such as _init_, _str_, comparison methods and Arithmetic methods etc.), Class Example, Inheritance, Inheritance and OOP.

Recommended Books:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated for Python 3, Shroff/OReilly Publishers, 2016.
2. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python-Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press , 2013
4. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
5. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd.,,2015.
6. Kenneth A. Lambert, Fundamentals of Python: First Programsl, CENGAGE Learning, 2012.
7. Charles Dierbach, Introduction to Computer Science using Python: A Computational ProblemSolving Focus, Wiley India Edition, 2013.

BTEC-514C	Credits	L	T	P	Int	Ext
VLSI/ULSI Technology	3	3	0	0	40	60

Course Objective: To study various VLSI fabrication steps such as oxidation, lithography, etc.

Course Outcomes:

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

1. understand the process of VLSI fabrication
2. Investigate the Oxidation processes for VLSI/ULSI device fabrication
3. Learn about the environment for VLSI/ULSI technology
4. Understand Lithography and deposition processes

Unit 1: VLSI Fabrication - Solid state diffusion modeling and technology, ion implantation technology and damage annealing, characterization of impurity profiles.

Unit 2: Oxidation - Kinetics of Silicon dioxide growth both for thick, thin and ultra thin films. Oxidation techniques in VLSI and ULSI, characterization of oxides films, low k and high k dielectrics for ULSI.

Unit 3: Environment for VLSI/ULSI Technology - Clean room and safety requirements, Wafer cleaning process and wet chemical etching techniques.

Unit 4 : Lithography and Deposition - Photolithography, e-beam lithography and newer lithography techniques for VLSI/ ULSI, mask generation. chemical vapor deposition techniques : CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitrite and metal films, epitaxial growth of silicon.
Metal film deposition: Evaporation and sputtering techniques, failure mechanisms in metal interconnect multilevel metallization schemes.

Plasma and rapid thermal processing, PECVD, plasma etching and RIE techniques, RTP techniques for annealing, growth and deposition of various films for use in ULSI

Text/Reference Books

1. VLSI Technology, S. M. Sze, McGraw Hill, II , 1988 REFERENCE BOOKS
2. VLSI fabrication principles, S. K. Gandhi, "John Wiley, New York",1983
3. ULSI Technology, C. Y. Chang. S. M. Sze, McGraw Hill companies,1996

BTEC-515C	Credits	L	T	P	Int	Ext
Biomedical Instrumentation	3	3	0	0	40	60

Course Objectives

This course emphasizes on the fundamental principles of various biomedical equipments, different biological signals, their acquisition and measurement. The course will be beneficial to the students to explore biomedical field for pursuing advanced education or career.

Course Outcomes

After undergoing this course, students will be able to

I. Learn about the different types of transducers and electrodes for biomedical applications.
II. Acquire knowledge of the various biomedical measurement devices with their electrical safety standards.
III. Comprehend the knowledge of cardio vascular and respiratory system measurements.
IV. Get acquainted with the medical imaging techniques and assisting & therapeutic equipments.

Unit 1: Transducers and Electrodes

Different types of transducer and their selection for biomedical applications; Inductive, Capacitive, Piezoelectric transducers. Thermistors: Radiation & chemical thermometry, Electrode theory and different types of electrodes, Internal electrodes, Micro electrodes, Polarization, Electrode behaviour, Electrode-skin interface.

Unit 2: Origin of Biopotentials

Electric activity of cells, Neuron resting potential, Nernst equation: ECG, EEG, EMG, Source of these potentials, Generation of signals, Recording. Electrical Safety in medical environment: Micro shock and macro shock hazards, Basic approaches to shock protection, Electrical safety standards.

Unit 3: Cardio Vascular and Respiratory System Measurements

Measurement of blood pressure, Cardiac output and cardiac rate. Respiratory mechanism, Measurement of gas volume, Flow rate, Carbon dioxide and oxygen concentration in exhaled air, Respiration controller.

Unit 4: Medical Imaging

Principles and applications of radiography, CAT scan, MRI, Ultrasonography, Nuclear medicine, Angiography, Fluoroscopy. Bio-effects of microwaves: Interaction of microwaves with biological systems, Diathermy, Biological hazards of microwaves as well as low frequencies.

Unit 5: Assisting and Therapeutic Devices

Cardiac pacemakers, Electrical stimulators, Defibrillators, Haemodialysis, Ventilators.

Recommended text and Reference Books

1. John G. Webster, Medical Instrumentation: Applications and Design, John Wiley and Sons.
2. C.Rajarao and S.K.Guha, Principles of Medical Electronics and Biomedical Instrumentation, Universities Press.
3. R.S.Khandpur, Handbook of Biomedical Instrumentation, TMH.
4. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, PHI.

Note: At least one question must be set from each unit/course outcome

BTHU-902C	Credits	L	T	P	Int	Ext
Human Resource Management	3	3	0	0	40	60

Syllabus attached at the end as provided by DASH department

BTEC-504C	Credits	L	T	P	Int	Ext
Analog and Digital Communication Lab	1	0	0	2	30	20

Course Objective

This laboratory course deals with the Hands-on experiments related to the study and investigate the outputs of various Analog and digital modulation techniques.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. study and verify the characteristics and output waveforms of AM, FM, PCM
2. study and compare noise in AM and FM systems
3. investigate the output responses of PAM, PCM, PSK, FSK, MSK.

List of Experiments:

1. To study the Characteristics/output waveform of Amplitude Modulation and demodulation techniques.
2. To Investigate and compare the outputs of SSB, DSB-SC and VSB Modulation systems.
3. To study and compare Noise Interference in AM and FM systems.
4. To study the effect of threshold in Angle modulation.
5. To study the effect of Sampling and Investigate the Output response of Pulse Amplitude Modulation.
6. To Investigate the Output response of Pulse Code Modulation.
7. To Study the output response of PSK & FSK.
8. To Study Delta modulation and demodulation technique and observe effect of slope overload.
9. To study the output response of QAM.
10. To study the output response of Continuous Phase Modulation.
11. To study the output response of Minimum Shift keying.
12. Digital link simulation; error introduction & error estimation in a digital link using MATLAB (SIMULINK)/ communication simulation packages.

BTEC-505C	Credits	L	T	P	Int	Ext
Linear Integrated Circuits Lab	1	0	0	2	30	20

Course Objective

This laboratory course deals with the Hands-on experiments related to the study of the concepts of Linear Integrated Circuits.

Course Outcomes

At the end of this course student will demonstrate the ability to:

1. Study and investigate the configurations of Differential amplifiers.
2. Measure the performance parameters of am OP-Amp.
3. Use Op-Amps for various applications.

List of Experiments (Minimum 10 experiments to be performed):

1. Study differential amplifier configurations.
2. Measure the performance parameters of an Op amp.
3. Application of Op amp as Inverting and Non Inverting amplifier.
4. Study frequency response of an Op Amp and determine Gain-Bandwidth product
5. Application of Op-Amp as summing, scaling & averaging amplifier.
6. Application of Op-Amp as Instrumentation amplifier
7. Design differentiator and Integrator using Op-Amp.
8. Design Low pass, High pass and Band pass 1st order Butterworth active filters using Op-amp
9. Design Phase shift and Wein Bridge oscillator using Op-Amp.
10. Application of Op Amp as square wave, triangular wave and Sawtooth wave generator.
11. Application of Op Amp as Zero Crossing detector and window detector.
12. Application of Op Amp as Schmitt Trigger.
13. Application of 555 as Monostable and Astable multivibrator.
14. Examine the operation of a PLL and determine the free running frequency, the capture range and the lock in range of PLL.

BTEC-506C	Credits	L	T	P	Int	Ext
Circuit Design Techniques-III Lab	3	0	0	6	60	40

Course Objective

This laboratory course is meant to enable students to learn in depth study/design and simulation of analog & digital modulation techniques and different types of Integrated circuits on trainer kits as well as in the simulation environment.

Course Outcomes

At the end of this course student will demonstrate the ability in the following:

1. Study and verify the output waveforms of AM, FM., PAM and PCM
2. Study and verify the output waveforms of PSK, FSK, QAM
3. Study and investigate the configurations of Differential amplifiers.
4. Measure the performance parameters of an OP-Amp.
5. Study of use of Op-Amps for various applications.

List of Experiments

1. To study the Characteristics/output waveform of Amplitude Modulation and demodulation techniques.
2. To Investigate and compare the outputs of SSB, DSB-SC and VSB Modulation systems.
3. To study the Characteristics/output waveform of Frequency Modulation and demodulation techniques.
4. To study the effect of Sampling and Investigate the Output response of Pulse Amplitude Modulation.
5. To Investigate the Output response of Pulse Code Modulation.
6. To Study the output response of PSK,FSK and QAM.
7. Digital link simulation; error introduction & error estimation in a digital link using MATLAB (SIMULINK)/ communication simulation packages.
8. Study differential amplifier configurations.
9. Measure the performance parameters of an Op amp.
10. Application of Op amp as Inverting and Non Inverting amplifier.
11. Study frequency response of an Op Amp and determine Gain-Bandwidth product
12. Application of Op-Amp as summing, scaling & averaging amplifier.
13. Design differentiator and Integrator using Op-Amp.
14. Design Phase shift and Wein Bridge oscillator using Op-Amp.
15. Application of Op Amp as square wave, triangular wave and Sawtooth wave generator.

BMPD-501C	Credits	L	T	P	Int	Ext
Mentoring and Professional Development*	Non-credit	0	0	2	S/US**	

* Guidelines regarding evaluation and rubrics of subject Mentoring and Professional Development as per MoM no. 4403 dated 23.10.19

**S/US - Satisfactory and Unsatisfactory

* Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A

(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B

(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B

Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

6th Semester

BTEC-601C	Credits	L	T	P	Int	Ext
Wireless Communication	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Wireless communication using suitable mathematical models.

Course Outcomes

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

1.Understand the basic elements of Cellular Radio Systems and its design

2.Learn about the concepts Digital communication through fading multipath channels

3.Understand various Multiple Access techniques for Wireless communication

4.Know about the Wireless standards and systems

Unit 1: Elements of Cellular Radio Systems Design: Basic cellular system, Performance criteria, Components and Operation of cellular systems, Planning a cellular system, Analog & Digital cellular systems, Concept of frequency reuse channels, Co-channel interference, Reduction factor, desired C/I for a normal case in an omni directional antenna system, Cell splitting.

Unit 2: Digital Communication through fading multipath channels:

Fading

channels and their characteristics- Channel modelling, Digital signalling over a frequency non selective slowly fading channel. Concept of diversity branches and signal paths. Combining methods: Selective diversity combining, Switched combining, Maximal ratio combining, Equal gain combining.

Unit 3: Multiple Access Techniques for Wireless Communications:

Introduction, Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access, Space Division Multiple Access (SDMA), Packet Radio Protocols; Pure ALOHA, Slotted ALOHA.

Unit 4: Wireless Systems & Standards: AMPS and ETACS, United states digital cellular (IS- 54 & IS 136), IEEE Standards, Global system for Mobile (GSM): Services, Features, System Architecture and Channel Types, Frame Structure for GSM, Speech Processing in GSM, GPRS/EDGE specifications and features. 3G systems: UMTS & CDMA 2000 standards and specifications. CDMA Digital standard (IS 95): Frequency and Channel specifications, Forward CDMA Channel, Reverse CDMA Channel, Wireless Cable Television.

Unit 5: Evolution of Communication Generations: Introduction to Bluetooth, Zigbee, LTE-Advance systems, 4G & 5G Mobile techniques and Emerging technologies.

Recommended Books:

1. T.S. Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Pearson Education Asia, 2010.

2. William C Y Lee, Mobile Cellular Telecommunications, 2nd Edition, MGH, 2004.

3. Raj Pandya, ―Mobile and Personal Communication systems and services‖, Prentice Hall of India, 2001.

4. Wireless and Digital Communications; Dr. Kamilo Feher (PHI), 1998.

Note: At least one question must be set from each unit/course outcome.

BTEC-602C	Credits	L	T	P	Int	Ext
Digital Signal Processing	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to know the concepts of Digital Signal Processing and understand the commonly used digital filters and systems.

Course Outcomes

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

1. Represent signals mathematically in continuous and discrete time and frequency domain
2. Get the response of an LSI system to different signals
3. Design of different types of digital filters for various applications

Unit 1: Discrete Time Signals

Elementary Discrete time sequences and systems; Representation of signals on orthogonal basis; Sampling and reconstruction of signals; Discrete systems attributes, Basic elements of digital signal processing such as convolution, correlation and autocorrelation, Concepts of stability, causality, linearity, difference equations. Implementation of Discrete Time Systems, Linear Periodic and Circular convolution, Z-Transform, Inverse Z-Transform methods, Properties of Z- Transform.

Unit 2: LSI Systems

Analysis of LSI systems, Frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) with their properties, Inverse DFT and FFT methods, Goertzel Algorithm.

Unit 3: Digital filters Design

Structures of realization of discrete time system, direct form, Cascade form, parallel form and lattice structure of FIR and IIR systems. Time Invariant and Bilinear Transformation Methods, Rectangular, Hamming and Hanning Window methods, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low pass, Band pass, Band stop and High pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Matched Z-Transformation, Analog and Digital Transformation in the Frequency Domain. Finite Precision Effects: Fixed point and Floating point representations, Effect of round off noise in digital filters, Limit cycles.

Unit 4: Introduction to Multirate signal processing and DSP processors

Concepts of Multirate Signal Processing, need and significance, Applications of DSP, Limitations of Analog signal processing, Advantages of Digital signal processing, Architectures of ADSP and TMS (C6XXX) series of processor.

Recommended Books

1. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH, 2001.
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
4. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
5. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
6. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

Note: At least one question must be set from each unit/course outcome.

BTEC-603C	Credits	L	T	P	Int	Ext
Microwave and Antenna Engineering	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Microwave and Antenna Engineering.

Course Outcomes

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

1. Understand the working and operation of various Microwave Tubes and Microwave Solid-state devices.
2. Learn about various important Microwave Components and the Microwave measurements that can be carried out.
3. Explain the basic concepts and types of Antennas and its regions.
4. Describe the important concepts of Antenna Arrays and Antenna Aperture.

Unit 1: Microwave Tubes and Solid-State devices: Limitations of Conventional tubes, construction, Operation and properties of Klystron Amplifier, reflex Klystron, Magnetron, Travelling Wave Tube (TWT), Backward Wave Oscillator (BWO), Crossed field amplifiers. Microwaves Transistors: (Bipolar, FET), Transferred Electron Devices (Gunn diode), Avalanche transit time effect (IMPATT, TRAPATT), Microwave Amplification by Stimulated Emission of Radiation (MASER).

Unit 2: Microwave Components and Measurements: Analysis of Microwave components using S-parameters, Junctions (E, H, Hybrid), Directional coupler, Bends and Corners, Microwave posts, S.S. tuners, Attenuators, Phase shifter, Ferrite devices (Isolator, Circulator, Gyrator), Cavity resonator, Matched termination. Power measurements using calorimeters and bolometers, Measurement of Standing Wave Ratio (SWR), Frequency and wavelength.

Unit 3: Antennas: Concept of radiation in Single wire, Two wire and Dipole, Introduction to Antenna parameters: Reflection Co-efficient, VSWR, Radiation pattern, Directivity, Gain. Infinitesimal dipole, Monopole and half wave dipole, Far-field, Radiating near-field and reactive near-field regions, Microstrip Patch & Fractal Antennas.

Unit 4: Antenna Arrays and Aperture Antennas: Array of two-point sources, Array factor, Array configurations, Hansen-woodyard end fire array, n-element linear array with uniform amplitude and spacing, n-element linear array with non-uniform spacing, Binomial and Dolph-Tschebysceff array. Aperture Antennas: Rectangular and circular aperture antennas, Horn antenna, Babinet's Principle, Slot Antenna, Loop antenna.

Recommended Books:

1. M.Kulkarni, Microwave and Radar Engineering, Umesh Publications, 5th Edition, 2018.
2. Jordan E.C., Electromagnetics and radiating systems, PHI 1995.
3. J.D.Krauss, Antenna Theory, McGraw Hill 1999.
4. C.A.Balanis, Antenna Theory, John Wiley & sons 4th Edition 2016.
5. R.L.Yadava, Antenna and wave propagation, PHI 2011

Department Electives of 6th Semester (Department Elective-II)

BTEC-611C	Credits	L	T	P	Int	Ext
Computer Networks	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Computer networking.

Course Outcomes

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

1. Explain the functions of the different layer of the OSI Protocol
2. Describe the function of each block of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs)
3. Develop the network programming for a given problem related TCP/IP protocol
4. Learn about DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

Unit 1: Data Communication - Data Communication System & its Components, Representation of data and its flow Networks, Various Connection Topologies, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization.

Unit 2: Data Link Layer and Medium Access Sub Layer - Design issues, Framing, Error detection and correction codes: checksum, CRC, hamming code, Data link protocols for noisy and noiseless channels, Sliding Window Protocols: Stop & Wait ARQ, Go-back-N ARQ, Selective repeat ARQ, Data link protocols: HDLC and PPP

Unit 3: Network Layer Switching - Logical addressing IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Unit 4: Transport Layer Process to Process Communication - User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Unit 5: Application Layer - Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), World wide web (WWW), HTTP, SNMP, Bluetooth, Firewalls.

Recommended Books:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw- Hill 2007.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India 2007.
3. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition 2013.
4. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India 2015.
5. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, USA 2012 .

BTEC-612C	Credits	L	T	P	Int	Ext
Robotics and Automation	3	3	0	0	40	60

Course Objective

The main objective of this course is to enlighten the students with the basic fundamentals of Robotics, Robotic Transformation, Simulation and programming along with the Embedded systems in Robotics so that they will be able to design the robots which would facilitate to the humans to solve the real world problems.

Course Outcomes

After undergoing this course, students will be able

1. To understand basic concept of robotics.
2. To analyze Instrumentation systems and their applications to various
3. To know about the differential motion, add statics in robotics
4. To know about the various path planning techniques.
5. To know about the dynamics and control in robotics industries.

Unit 1 - Basic Concepts

Brief history-Types of Robot-Technology-Robot classifications and specifications-Design and control issues-Various manipulators-Sensors-work cell-Programming languages.

Unit 2 - Direct and Inverse Kinematics

Mathematical representation of Robots-Position and orientation- Homogeneous Transformation-Various Joints-Representation using the Denavit Hattenberg parameters-Degrees of freedom-Direct Kinematics-Inverse kinematics-SCARA robots-Solvability-Solution Methods-Closed form solution.

Unit 3- Manipulator Differential Motion And Statics

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints-Inverse-Wrist and arm singularity-Static Analysis-Force and moment Balance.

Unit 4 - Path Planning

Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique-Parametric Descriptions-Straight line and circular paths-Position and orientation planning.

UNIT 5 - Robotics System Design

Running Code on Microcontroller-Voltage, Current and power-ARM Cortex M-Software Design-Battery and Voltage Regulation-GPIO-Interfacing Input and Output-DC Motors-Timers-Bluetooth Low Energy.

Recommended Books:

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
2. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education,2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-HillSingapore, 1996.
4. Jonathan W. Valvano, Embedded Systems: Introduction to Robotics, First Edition,2019
5. TI Robotic System Design Lab-RSLK (https://university.ti.com/en/faculty/ti-robotics-system-learning-kit/ti-robotics-system-learning-kit)

Note: At least one question must be set from each unit/course outcome.

BTEC-613C	Credits	L	T	P	Int	Ext
Neural Networks & Fuzzy Logic	3	3	0	0	40	60

Course Objective

The Objective is to develop the skills to gain a basic understanding on fuzzy logic theory and neural networks and use these for controlling real time systems.

Course Outcomes

After undergoing this course, students will be able to

I. Understand the learning and working of basic artificial neural models and their network topologies.
II. Get exposure of feed forward neural networks.
III. Gain knowledge about basic learning laws of various neural models.
IV. Learn the basic concepts and working of fuzzy Logic sets and components to develop and implement a basic trainable neural network or a fuzzy logic system for any application.

Unit-1: Introduction to Neural Networks

Introduction, Humans and computers, Organization of the brain, Biological neuron, Difference between biological and artificial neuron models, Characteristics of ANN, Historical developments, Potential applications of ANN, Different artificial neuron models, Operations of artificial neuron, Types of neuron activation function, ANN architectures, Classification taxonomy of ANN, Connectivity, Neural dynamics (Activation and synaptic), Network topologies, Learning strategy (Supervised, unsupervised, reinforcement), Learning rules.

Unit–2: Single Layer and Multilayer Feed- Forward Neural Networks

Perception models: Discrete, continuous and multi-Category, Training algorithms: Discrete and continuous perception networks, Perception convergence theorem, Limitations of the perception model, Applications. Credit assignment problem, Generalized delta rule, Derivation of back propagation (BP) training, Summary of back propagation algorithm, Kolmogorov theorem, Learning difficulties and improvements.

Unit-3: Learning Rules and Neural Models

Learning laws: Hebb's rule, Delta rule, Windrow & Hoff LMS learning rule, Correlation learning rule, Instars and out-star learning rules, Back-propagation neural networks, K-means clustering algorithm, Kohenen's feature maps, Associative memories, Hodgkin-Huxley neuron model, Spiking neuron model.

Unit-4: Fuzzy Sets and Components

Classical sets, Operations and relations, Fuzzy sets and its properties, Fuzzy relations, Membership functions, Fuzzification, Development of rule base and decision making system, De-fuzzification and its techniques, Fuzzy logic system: Block diagram, Implementation, Fuzzy logic controller Vs PID controller.

Unit –5: Application of Fuzzy Logic Control

Inverted pendulum, Image processing, Home-heating system, Blood pressure during anesthesia, Introduction to neuro-fuzzy controller, Antilock Braking System (ABS).

Recommended Text and Reference Books

1. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley publications.
2. Yegnanarayanan, Artificial Neural Networks, Prentice Hall of India Pvt. Ltd.
3. Bart Kosko, Neural Networks & Fuzzy Logic, Prentice Hall.
4. Simon S. Haykin, Neural Networks, Prentice Hall.

Note: At least one question must be set from each unit/course outcome.

BTEC-614C	Credits	L	T	P	Int	Ext
Introduction to Big Data	3	3	0	0	40	60

Course Objective

This course deals with knowledge of fundamentals, architecture and concepts for better understanding of Introduction of Big Data.

Course Outcomes

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

1. Understand the Evolution and basics of Big Data.
2. Understand the Architecture of Hadoop with its file system and its Programming.
3. Explain the Advanced analytical theory and methods.
4. Describe the challenges in handling streaming data from the real world.

Unit 1 - Evolution & Introduction to Big data

Best Practices for Big data Analytics, Big data characteristics, Validating - The Promotion of the Value of Big Data, Big Data Use Cases, Characteristics of Big Data Applications, Perception and Quantification of Value, Understanding Big Data Storage.

Unit 2 - A General Overview of High Performance Architecture

HDFS, Map Reduce and YARN - Map Reduce Programming Model. Big Data Overview Analysis of data at Rest-Hadoop analytics: Limitations of existing distributing systems, Hadoop Approach, Hadoop Architecture, Distributed file system: HDFS and GPFS, Internals of Hadoop MR engine, Hadoop cluster components, Hadoop Ecosystem, Evaluation criteria for distributed Map Reduce runtimes, Enterprise-grade Hadoop Deployment, Hadoop Implementation

Unit 3 - Advanced Analytical Theory and Methods

Overview of Clustering - K-means, Use Cases, Overview of the Method, Determining the Number of Clusters, Clustering, Classification, Segmentation, Linear regression, ML Search: Indexing and Indexing Techniques, Create inverted index using JAQL, Data Explorer Bundling Hadoop job: Application, Diagnostics, Reasons to Choose and Cautions, Classification: Decision Trees, Overview of a Decision Tree, The General Algorithm - Decision Tree Algorithms, Evaluating a Decision Tree

Unit 4 - Real time analytics

Introduction to streams computing, Challenges/limitations of conventional Systems, Solving a real time analytics problem using conventional system, Challenges to be solved - scalability, thread pooling, etc., Understanding the challenges in handling streaming data from the real world and how to address those using stream computing, Benefits of stream computing in Big Data world, Realtime Analytics Platform (RTAP),Real Time Sentiment Analysis.

Recommended Books

1. Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, by Chris Eaton, Paul Zikopoulos, Wiley Publication 2015.
2. Big Data Analytics: Turning Big Data into Big Money By Frank J. Ohlhorst, McGraw Hill 2012.
3. Ethics of Big Data: Balancing Risk and Innovation By Kord Davis, 2011.
4. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends, By Michael Minelli, Michele Chambers, Ambiga Dhiraj, Wiley Publication 2013.

Note: At least one question must be set from each unit/course outcome.

BTEC-615C	Credits	L	T	P	Int	Ext
Wireless Sensor Networks	3	3	0	0	40	60

Course Objective

This course aims at imparting the knowledge of Wireless Sensor Networks (WSN) basics, diverse topologies & routing techniques; along with latest simulative/designing tools for their implementation.

Course Outcomes

After undergoing this course students will be able to

I. Understand concepts related to wireless sensor networks & various application areas of WSN.
II. Be familiar with various concepts of WSN topology control.
III. Learn concepts of routing & various protocols used in WSN.
IV. Be acquainted with different platforms for design and implement of WSN.

Unit 1: Introduction to Wireless Sensor Networks

Constraints and challenges of sensor networks, Emerging technologies for wireless sensor networks, Node architecture, Hardware components overview, Energy consumption of Sensor nodes, Dynamic energy and power management on system level, Optimization goals and figures of merit, QOS, Energy efficiency, Scalability, Robustness, Advantages of sensor networks, Sensor network applications.

Unit 2: Topology Control

Location driven, Connectivity driven, Geographic Adaptive Fidelity (GAF) and Geographic Random Forwarding.

Unit 3: WSN Protocols

Physical layer design, Transceiver design, MAC protocols for WSN, Low duty cycle protocols & wakeup concepts, Mediation device protocol, Wakeup radio concepts, Address & name management, Assignment of MAC addresses, Routing protocols, Energy efficient routing, Geographic routing.

Unit 4: WSN Tools

Sensor-node hardware, Berkeley motes, Introduction of different simulators/emulators for designing of WSN networks, MATLAB designing.

Recommended Text and Reference Books

1. Holger Karl & Andreas Willig, Protocols & Architectures for Wireless Sensor Networks, John Wiley.
2. Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks - An Information Processing Approach, Elsevier.
3. Waltenegus Dargie & Christian Poellabauer, Fundamentals of Wireless Sensor Networks - Theory and Practice, John Wiley and Sons.

Note: At least one question must be set from each unit/course outcome.

BTEC-604C	Credits	L	T	P	Int	Ext
Digital Signal Processing Lab	1	0	0	2	30	20

Course Objective

This laboratory course deals with the Hands-on experiments related to the study of Digital Signal Processing and its applications.

Course Outcomes: At the end of this course student will demonstrate the ability to:

1. Write programs to develop various signals.
2. Write programs to generate standard sequences.
3. Develop programs to verify convolution
4. Develop programs to design various filters.

List of Experiments:

Perform the following exercises using MATLAB

1. To develop elementary signal function modules (m-files) for unit sample, unit step, exponential and unit ramp sequences.
2. Write a program in MATLAB to generate standard sequences.
3. Write a program in MATLAB to compute power density spectrum of a sequence.
4. To develop program modules based on operation on sequences like signal Shifting, signal folding, signal addition and signal multiplication.
5. To develop program for finding magnitude and phase response of LTI system described by system function H(z).
6. To write a MATLAB programs for pole-zero plot, amplitude, phase response and impulse response from the given transfer function of a discrete-time causal system.
7. Implementation Linear and Circular Convolution
8. To Find DFT and IDFT of given time DT Signal
9. N point FFT Algorithm implementation
10. Digital Filter Design – FIR and IIR Filter Implementation

BTEC-605C	Credits	L	T	P	Int	Ext
Microwave and Antenna Engineering Lab	1	0	0	2	30	20

Course Objective

This is basic course meant to give hands on experience of various types of Microwave components and important measurements related to Microwave and Antenna Engineering.

Course Outcomes

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

1. Learn about general Microwave components and Microwave bench.
2. Measure common parameters related to Microwave Oscillator(s).
3. Determine frequency and wavelength of waveguides.
3. Measure and plot radiation patterns of various types of Antennas.

List of Experiments:

The student has to perform 8 to 10 Experiments from the below:

1. To study various Microwave Components and Instruments.
2. To study the V-I Characteristics of Gunn Diode Oscillator at X-band.
3. To study Output power and Frequency as a function of voltage using Gunn Diode Oscillator at X-band.

4. To Study the characteristics of a Reflex Klystron oscillator. To determine the Standing Wave Ratio (SWR) and Voltage standing wave ratio (VSWR).
5. To measure the dielectric constant of a material at X-band.
6. To determine the frequency & wavelength in a rectangular waveguide.
7. Measurement of coupling factor and Isolation of a Directional coupler using X-band.
8. To measure the Attenuation/Insertion Loss of an attenuator.
9. Determination of the phase-shift of a phase shifter.
10. To plot the Radiation pattern of an antenna.
11. To study Simple Dipole (λ/2 or λ/4 or 3λ/2) antenna (all or any of these single dipole antennas) and Folded Dipole λ/2 antenna.
12. To study 3/5/7-element Yagi-Uda Folded Dipole antenna.
13. To study the Radiation pattern, Gain, Directivity of a Slot/Loop Antenna.

BTEC-606C	Credits	L	T	P	Int	Ext
Circuit Design Techniques-IV Lab	3	0	0	6	60	40

Course Objective

This laboratory course is meant to enable students to learn in depth study/design and simulation of different types of antennas and various signal processing techniques in the software environment.

Course Outcomes

At the end of this course student will demonstrate the ability in the following:

1. Study the performance of dipole antenna
2. Study the performance of patch and slot antennas.
3. Study of software environments Labview/Simulink/MATLAB for the implementation of experiments of digital signal processing
4. Study of bio-signals, audio signals and images.

List of Experiments

1. To study the performance parameters of simple Dipole antenna.
2. To study the (a) performance parameters of Microstrip patch antenna (b) Different types of antenna feeding techniques.
3. To study the performance parameters of Slot antenna.
4. Generation and display of signals using labview/simulink..
5. Signal operations (Addition, Subtraction, Multiplication) using labview/simulink.
6. Signal convolution using Labview/Simulink.
7. Finding DFT and IDFT of signal using labview/simulink.
8. Study of integration and differentiation operations in SIMULINK.
9. Implementation of PID controller in SIMULINK Environment.
10. Study of Audio Input and Output in software environment.
11. Implementation of Audio Delay, Echo and Audio Reverberation in software environment.
12. Loading of images of different types in MATLAB.
13. Study of Operations on images using MATLAB.
14. Study of biomedical instrumentation kit
15. Study of bio-signals in software environment.

BMPD-601C	Credits	L	T	P	Int	Ext
Mentoring and Professional Development*	Non-credit	0	0	2	S/US**	

* Guidelines regarding evaluation and rubrics of subject Mentoring and Professional Development as per MoM no. 4403 dated 23.10.19

**S/US - Satisfactory and Unsatisfactory

* Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A

(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B

(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B

Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

7th Semester

BTEC-701C	Credits	L	T	P	Int	Ext
Optical Fibers & Communication	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Optical Fibres and Communication.

Course Outcomes

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

1. Understand the basics of Optical Communication and Optical fibres
2. Learn about the Optical Transmitters and Receivers
3. Explain the Light wave Architecture and systems
4. Ability to explain the manufacturing, modulation and wave mixing in Optical Communication

Unit 1: Introduction

Need of Fiber Optic Communications, Evolution of Light wave Systems, Channel Multiplexing, Modulation Formats, Optical Communication Systems, Light wave System Components; Optical Fibers as a Communication Channel, Optical Transmitters, Optical Receivers.

Unit 2: Optical Fibers

Geometrical-Optics Description; Step-Index Fibers, Graded Index Fibers, Wave Propagation; Maxwell's Equations, Fiber Modes, Single-Mode-Fibers, Dispersion in Single-Mode Fibers; Group Velocity Dispersion, Material Dispersion, Wave guide Dispersion, Higher-order Dispersion, Polarization-Mode Dispersion, Dispersion-Induced Limitations; Basic Propagation Equation, Chirped Gaussian Pulses, Limitations on the Bit Rate, Fiber Bandwidth, Fiber Losses; Attenuation Coefficient, Material Absorption, Rayleigh Scattering, wave guide Imperfections, Nonlinear Optical effects; Stimulated Light Scattering, Nonlinear Phase Modulation, Four Wave Mixing, Fiber Manufacturing; Design Issues, Fabrication Methods, Cables and Connectors.

Unit 3: Optical Transmitters

Basic Concepts; Emission and Absorption Rates, p-n Junctions, Non radiative Recombination, Semiconductor Materials, Light Emitting Diodes; Power-current Characteristics, LED spectrum, Modulation Response, LED Structures, Semiconductor Lasers; DFB Lasers, Coupled Cavity Semiconductor Lasers, Tunable Semiconductor Lasers, Vertical Cavity Semiconductor Lasers, Laser Characteristics, Small & Large Signal Modulation, Spectral Line width.

Unit 4: Optical Receivers

Basic concepts, p-n Photo Diodes, p-i-n Photo Diodes, Avalanche Photo Diode, MSM Photo detector, Receiver Design, Receiver Noise; Noise mechanism, Receiver sensitivity; Bit error rate, Minimum Receiver Power, Sensitivity Degradation, Receiver Performance.

Unit 5: Light Wave Systems

Overview: System Architecture, Loss limited Light wave systems, Dispersion limited Light wave systems, Power Budget, Long Haul systems, Sources of Power Penalty; Model Noise, Dispersive Pulse Broadening, Mode Partition Noise, Frequency Chirping, Reflection Feedback Noise, WDM Light wave systems, Optical TDM Systems.

Recommended Books:

1. Senior J. Optical Fiber Communications, Principles & Practice, PHI 1985.
2. Keiser G., Optical Fiber Communication, Mc Graw-hill 2008.
3. Govind P. Agrawal, Fiber Optics Communication Systems, John Wiley & Sons (Asia) Pvt. Ltd 1998.
4. Djafar K. Mynbeav, Fiber-Optics Communications Technology, Pearson 2001.

BTEC-702C	Credits	L	T	P	Int	Ext
VLSI Design	3	3	0	0	40	60

Course Objective

This course offers a profound understanding of the design of digital VLSI circuits & systems, computer aided simulation and synthesis tool for hardware design.

Course Outcomes

After undergoing this course students will be able to

I. Recognize various VHDL keywords and statements.
II. Design combinational circuits based on various design approaches in VHDL.
III. Design sequential circuits based on various design approaches in VHDL
IV. Implement circuits using ROM & PLDs and know the basics of FPGA and CPLD.

Unit 1: Introduction

Introduction to Computer-aided design tools for digital systems. Hardware description languages, Introduction to VHDL, Data objects, Classes and data types, Operators, Overloading, Logical operators, Types of delays, Entity and Architecture declaration, Introduction to behavioural, Dataflow and structural models.

Unit 2: VHDL Statements

Assignment statements, Sequential statements and process, Conditional statements, Case statements, Array and loops, Resolution functions, Packages & Libraries, Concurrent statements.

Unit 3: Combinational Circuit Design

VHDL models and simulation of combinational circuits: Multiplexers, Demultiplexers, Encoders, Decoders, Code converters, Comparators, Implementation of Boolean functions.

Unit 4: Sequential Circuit Design

VHDL Models and simulation of sequential circuits: Flip-flops, Shift registers, Counters.

Unit 5: Programmable logic devices

ROM, PLAs, PALs, CPLDs and FPGA, Implementation using ROM and PLDs.

Recommended Text and Reference Books

1. Neil H. E. Weste, Principles of CMOS VLSI Design, Pearson Education.
2. Kohavi, Switching & Finite Automata Theory, TMH.
3. Samuel C. Lee, Digital Circuits and Logic Design, PHI Learning.
4. Jr. Charles H. Roth, Larry L Kinney, Fundamentals of Logic Design, Jaico Publishing House.
5. Parag K. Lala, Fault Tolerant and Fault Testable Hardware Design, BS Publications.

Note: Atleast one question must be set from each unit/course outcome.

BTEC-703C	Credits	L	T	P	Int	Ext
Embedded System Design	3	3	0	0	40	60

Course Objective

This course deals with the concepts and design requirements for understanding the Embedded System Design and its fundamentals.

Course Outcomes

After the completion of this course, the student will be able to

- Learn about the basic architecture of 32-bit microcontrollers
- Understand hardware interfacing concepts to connect digital as well as analog sensors while ensuring low power considerations.
- Reviews and implement the protocols used by microcontroller to communicate with external sensors and actuators in real world.
- Understand Embedded Networking concepts based upon connected MCUs

Unit-1: Introduction to Embedded systems

Embedded system overview and applications, features and architecture considerations-ROM, RAM, timers, data and address bus, Memory and I/O interfacing concepts, memory mapped I/O. CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture, instruction set, instruction formats, and various addressing modes of 32-bit. Fixed point and Floating point arithmetic operations.
Introduction to ARM architecture and Cortex - M series, Introduction to the Tiva family viz. TM4C123x(Cortex M4F) and its targeted applications, block diagram, address space, on-chip peripherals (Analog and Digital) Register sets, Addressing modes and instruction set basics.

Unit-2: Microcontroller Fundamentals for Basic Programming

I/O pin multiplexing, pull up/down registers, GPIO control, Memory Mapped Peripherals, programming System registers, Watchdog Timer, need of low power for embedded systems, System Clocks and control, Introduction to Interrupts, Interrupt vector table, interrupt programming.

Unit- 3: Timers, PWM and Mixed Signals Processing

Timer, Basic Timer, Real Time Clock (RTC), Timing generation and measurements, Analog interfacing and data acquisition: ADC, Analog Comparators, DMA, Motion Control Peripherals: PWM Module & Quadrature Encoder Interface (QEI).

Unit-4: Communication protocols and Interfacing with external devices

Synchronous/Asynchronous interfaces (like UART, SPI, I2C, USB), serial communication basics, baud rate concepts, Interfacing digital and analog external device, I2C protocol, SPI protocol & UART protocol. Implementing and programming I2C, SPI & UART interface and CAN & USB interfaces on TM4C123x .

Unit 5: Embedded networking

Embedded Networking fundamentals, Ethernet, TCP/IP introduction, Overview of wireless sensor networks and design examples. Various wireless protocols and its applications: NFC, ZigBee, Bluetooth, Bluetooth Low Energy, Wi-Fi.

Recommended Books

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

Note: At least one question must be set from each unit/course outcome.

Department Electives of 7th Semester (Department Elective-III)

BTEC-711C	Credits	L	T	P	Int	Ext
Artificial Intelligence	3	3	0	0	40	60

Course Objective

The main objective of this course is to enlighten the students with the basic fundamentals of Artificial Intelligence Networks, Systems, Methods and parameters.

Course Outcomes

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

- Learn about the basic understanding of Artificial Intelligent system
- explain about various types of Artificial Neural Networks & their models
- describe Artificial Neural networks methods, operation and parameters
- explore Neural Network MATLAB Toolbox

Unit 1 - Introduction

Approaches to intelligent control, Architecture of intelligent control, Linguistic reasoning, Rulebase, Knowledge representation.

Unit 2 - Artificial Neural Networks

Biological neuron, Artificial Neural Network (ANN), Mathematical Models, McCulloch Neural Model, Perceptron, Adaline and Madaline, Learning & Training in ANN, Hopfield Neural Network, Self Organizing Networks, Recurrent Networks, Associative memories.

Unit 3 - Fuzzy Logic System

Crisp Vs Fuzzy set theory, Membership functions, Fuzzy set operations, Fuzzy rules, Mamdani and Sugeno fuzzy inference systems, Defuzzification methods.

Unit 4 - ANN Methods and Parameters

Introduction and biological background of GA, String Encoding of chromosomes, Selection methods, Single & multi-point crossover operation, Mutation, Adjustment of strategy parameters such as Population size, Mutation & Crossover probabilities.

Unit 5 - Fuzzy Logic MATLAB Toolbox

Fuzzy Logic Toolbox, Neural Network Toolbox, FLS for Antilock Breaking System (ABS), GA in route planning for Travelling Sales Person, Time-Series forecasting using ANN.

Recommended Books

1. Jacek M. Zurada - Introduction to Artificial Neural Systems, PWS Publishing Company 1995.
2. S N Sivanandam, S N Deepa - Principles of Soft Computing, Wiley Publications, 2007.
3. John Yen, Reza Langari - Fuzzy Logic Intelligence, Control, and Information, Pearson 1998.

Note: At least one question must be set from each unit/course outcome.

BTEC-712C	Credits	L	T	P	Int	Ext
Satellite Communication	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to the understanding of Satellite Communication.

Course Outcomes

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

1. Visualize the architecture of satellite systems as a means of high speed, high range communication system.
2. State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
3. Understand phenomena in satellite communication.
4. Understand the general link design equation and the concepts related to it.
5. Learn about VSAT system and its applications

Unit 1 - Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication, Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.

Unit 2 - Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Altitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc.

Unit 3 - Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Doppler frequency shift phenomena and expression for Doppler shift. Received signal power equations.

Unit 4 - Satellite Link Design: Introduction, General Link Design Equations, System Noise Temperature C/N and G/T Ratio, Atmospheric and Ionospheric Effects on Link design, Uplink design, Complete Link Design, Interference effects on Complete Link design, Earth Station Parameters.

Unit 5 - VSAT Satellite Systems: Introduction, Network Architecture, VSAT Earth Station, VSAT Applications.

Recommended Books:

1. Trimothy Pratt, Charles W. Bostian, —Satellite Communications||, John Wiley & Sons, 1986.
2. Dr. D.C. Aggarwal, —Satellite Communications||, Khanna Publishers, 2001.
3. Dennis Roddy, —Satellite Communications||, McGraw Hill, 1996.

Note: At least one question must be set from each unit/course outcome.

BTEC-713C	Credits	L	T	P	Int	Ext
Programming in JAVA	3	3	0	0	40	60

Course Objective

The prime objective of this course is to introduce the concepts of Java Programming language to enhance the programming skills of ECE students in Java.

Course Outcomes

After this course the students will be able to: -

1. Apply the concepts and basics of JAVA
2. Demonstrate the knowledge of operators and control statements
3. Ability to learn about Inheritance, Interface, Applets.
4. Learn about JAVA database connectivity

Unit 1 - Introduction to Java: History of Java, Features of Java, Java Development Kit (JDK), Security in Java, Java Basics: Keywords; Working of Java; Including Comments; Data Types in Java; Primitive Data Types; Abstract / Derived Data Types; Variables in Java; Using Classes in Java; Declaring Methods in Java, Code to Display Test Value; The main() Method, Invoking a Method in Java; Saving, Compiling and Executing Java Programs

Unit 2 - Operators and Control Statements: Operators, Arithmetic Operators, Increment and Decrement Operators, Comparison Operators, Logical Operators, Operator Precedence; Control Flow Statements, If-else Statement, Switch Statement, For Loop, While Loop, Do…While Loop, Break Statement Continue Statement

Arrays and Strings: Arrays; String Handling; Special String Operations; Character Extraction; String Comparison; Searching Strings; String Modification; StringBuffer

Unit 3 - Inheritance, Package and Interface: Inheritance, Types of Relationships, What is Inheritance?, Significance of Generalization, Inheritance in Java, Access Specifiers, The Abstract Class; Packages, Defining a Package, CLASSPATH; Interface, Defining an Interface, Some Uses of Interfaces, Interfaces versus Abstract Classes Exception Handling: Definition of an Exception; Exception Classes; Common Exceptions; Exception Handling Techniques, Streams in Java: Streams Basics; The Abstract Streams; Stream Classes; Readers and Writers; Random Access Files; Serialization

Unit 4 - Applets: What are Applets?; The Applet Class; The Applet and HTML; Life Cycle of an Applet; The Graphics Class; Painting the Applet; User Interfaces for Applet; Adding Components to user interface; AWT (Abstract Windowing Toolkit) Control, Event Handling: Components of an Event; Event Classes; Event Listener; Event-Handling; Adapter Classes; Inner Classes; Anonymous Classes, Swing: Concepts of Swing; Java Foundation Class (JFC); Swing Packages and Classes; Working with Swing- An Example; Swing Components

Unit 5 - Java Data Base Connectivity: Java Data Base Connectivity; Database Management; Mechanism for connecting to a back end database; Loading the ODBC driver, RMI, CORBA and Java Beans: Remote Method Invocation (RMI); RMI Terminology; Common Object Request Broker Architecture (CORBA), What is Java IDL?, Example: The Hello Client-Server; Java Beans, The BeanBox, Running the BeanBox.

Recommended Books:

1. Patrick Naughton & Herbert Schildt, Java: The Complete Reference, Tata McGraw Hill.
2. Balagurusamy, Programming with JAVA: A Primer, McGraw Hill.
3. Deitel and Deitel, Java: How to Program, Pearson Education.

Note: At least one question must be set from each unit/course outcome.

BTEC-714C	Credits	L	T	P	Int	Ext
Mobile Computing	3	3	0	0	40	60

Course Objective

The Objective of this course for is to provide the students in-depth knowledge and understanding of mobile computing infrastructure, principles, technologies, and applications in different domains.

Course Outcomes

After undergoing this course, students will be able to

I. Understand the basic concepts of mobile computing, components and its applications.
II. Acquire knowledge of the concepts of mobile hardware and operating system.
III. Develop understanding of mobile internet and wireless technologies.
IV. Know about the architecture and techniques for mobile application development.

Unit 1: Overview of mobile computing

Introduction to mobile computing, Basic building blocks of mobile computing based systems, Hardware and software components, Principles of mobile computing, Mobile computing devices, In-vehicle computing and fleet computing, Portable computing devices, Security issues, Limitations, Mobile computing applications: Internet of things, Smart home and office environment, Intelligent traffic control systems, Social computing techniques, Wearable computing.

Unit 2: Mobile Hardware and Operating System

Mobile device architecture and hardware, Mobile operating system, Operating system structure, Constraints and restrictions, Hardware configuration with mobile operating system, Features: Multitasking scheduling, Memory allocation, File system interface, Keypad interface, I/O interface, Protection and security, Multimedia features. Energy modelling and management: Battery models, Energy models and relative energy consumption of components, Dynamic Voltage and Frequency Scaling (DVFS), Power modes, Cooperative energy conservation. Case study: Android, iOS.

Unit 3: Overview of Mobile Internet and Wireless Technologies

Overview of mobile internet protocol: MIP. Mobile internet protocol version 6: MIPv6. Wireless application protocols: WAP Architecture and protocol suite. Bluetooth: Architecture, network, protocols. Overview of wireless LAN protocols: Wi-Fi, WiMAX – 802.16.

Unit 4: Mobile Application Development

Architecture of mobile software applications, Introduction to mobile development frameworks and tools, Workflow for mobile application development, Techniques for composing applications: Java, Brew, Windows CE, Symbian, WAP, Android, Location information, GIS, Location information modeling, Utilizing location based services with mobile applications, Localization and internationalization, Techniques and tools for design and development of applications in Android.

Recommended Text and Reference Books

1. J. Schiller, Mobile Communications, Addison-Wesley.
2. Raj Pandya, Mobile & Personal Communication: Systems and Services, Wiley.
3. Asoke k Talukder & Roopa R Yavagal, Mobile Computing: Technology, Application & Service Creation, Tata Mc Graw Hill.
4. Anubhav Pradhan, Anil V Deshpande, Mobile Apps Development, Wiley.
5. Jeff McWherter, Scott Gowell, Professional Mobile Application Development, John Wiley & Sons.

Note: At least one question must be set from each unit/course outcome.

BTEC-715C	Credits	L	T	P	Int	Ext
Deep Learning	3	3	0	0	40	60

Course Objective: To make the student understand the concepts of Deep Learning

Course Outcomes

After undergoing this course, the students will be able to:

1. Comprehend the advancements in learning techniques
2. Compare and explain various deep learning architectures and algorithms.
3. Demonstrate the applications of Convolution Networks
4. Apply Recurrent Network for Sequence Modelling
5. Deploy the Deep Generative Models

UNIT 1: Machine Learning Basics: Learning, Under-fitting, Overfitting, Estimators, Bias, Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning, Unsupervised Learning and Stochastic Gradient Decent.

UNIT 2: Deep Feedforward Network: Feed-forward Networks, Gradient-based Learning, Hidden Units, Architecture Design, Computational Graphs, Back-Propagation, Regularization, Parameter Penalties, Data Augmentation, Multi-task Learning, Bagging, Dropout and Adversarial Training and Optimization.

UNIT 3: Convolution Networks: Convolution Operation, Pooling, Basic Convolution Function, Convolution Algorithm, Unsupervised Features and Neuroscientific for convolution Network.

UNIT 4: Sequence Modelling: Recurrent Neural Networks (RNNs), Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Network, Recursive Neural Networks and Echo State networks.

UNIT 5: Deep Generative Models: Boltzmann Machines, Restricted Boltzmann Machines, Deep Belief Networks, Deep Boltzmann Machines, Sigmoid Belief Networks, Directed Generative Net, Drawing Samples from Auto –encoders.

Recommended Books:

1. Goodfellow L., Bengio Y. and Courville A., Deep Learning, MIT Press (2016).
2. Patterson J. and Gibson A., Deep Learning: A Practitioner's Approach, O'Reilly (2017), 1st ed.
3. Haykin S., Neural Network and Machine Learning, Prentice Hall Pearson (2009), 3rd ed.
4. Geron A., Hands-on Machine Learning with Sci-kit and TensorFlow, O'Reilly Media (2017)

Note: At least one question must be set from each unit/course outcome.

BTEC-704C	Credits	L	T	P	Int	Ext
Optical Fibers & Communication Lab	1	0	0	2	30	20

Course Objective

This is one of the experimental courses meant to understand the important concepts related to Optical Fibres and Communication.

Course Outcomes

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

1. To perform experiments based on optical communication in order to understand in depth concepts of latest communication system.
2. To study various types of optical sources and light detectors
3. To know methods of slicing and connecting techniques of optical fibers
4. To study different types of losses in optical fibers.
5. To know applications of optical fibers.

List of Experiments:

The student has to perform 8 to 10 Lab experiments from the below:

1. Study and measurement of Attenuation and Loss in optical fiber.
2. Study and measurement of bending loss in optical fiber.
3. Study and measurement of numerical aperture of optical fiber.
4. Measurement of optical power using optical power meter.
5. To Study the transmission of TDM signal through optical fiber.
6. To determine the bit rate of the optical fiber link.
7. Study of various multiplexing techniques.
8. To determine the BER of wireless system using M-ARY (BPSK,QPSK,8PSK,16PSK) and QAM technique.
9. To learn fiber splicing techniques and to become familiar with the use of optical time domain reflectometry in characterizing optical fibers.
10. To establish fiber optic analog link and to study the relationship between the input signal & received signal.
11. To study the VI characteristics of fiber optic source and Photo Detector.
12. Simulation of an optical communication system & calculation of its BER and Q factor using simulator.

BTEC-705C	Credits	L	T	P	Int	Ext
VLSI Design Lab	1	0	0	2	30	20

Course Objective:

The objective of this course is to make the students understand the use of VHDL statements and syntax for implementation and designing digital circuits in VHDL.

Course Outcomes:

After undergoing this course students will be able to:

I. Write VHDL code and simulate combinational digital circuits.
II. Write VHDL code and simulate sequential digital circuits.
III. Verify the output of combinational and sequential digital circuits with different input combinations.

List of Experiments:

Combinational Design Exercises

1. Design of AND, OR, XOR Gates
2. Design of 4:1 MUX using other basic gates
3. Design of 3 to 8 Decoder
4. Design of Half-Adder, Full Adder, Half Subtractor, Full Subtractor
5. Design of 8:3 Priority Encoder
6. Design of 4 Bit Binary to Grey code Converter
7. Design of 1's and 2's complementing circuit.

Sequential Design Exercises

8. Design of all type of Flip-Flops
9. Design of 8-Bit Shift Register with shift Right, Shift Left, Load and Synchronous reset.
10. Design of Synchronous 8-bit Johnson Counter.
11. Design of Synchronous 8-Bit universal shift register (parallel-in, parallel-out)
12. Design of 4 Bit Binary to BCD Converter using sequential statement.
13. Design of Mod 5, Mod 8, Mod 16 Counter and 4 bit Johnson counter
14. Design of decimal up/down counters that counts up from 00 to 99 or down from 99 to 00.

BTEC-706C	Credits	L	T	P	Int	Ext
Major Project	4	0	0	8	120	80

The objective of Major Project is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor.

This is expected to provide a good initiation for the student(s) in R&D work. The assignment may normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.

The project must involve originality, innovation and business idea. Assessment will be based on the work performance & report submitted.

BMPD-701C	Credits	L	T	P	Int	Ext
Mentoring and Professional Development*	Non-credit	0	0	2	S/US**	

* Guidelines regarding evaluation and rubrics of subject Mentoring and Professional Development as per MoM no. 4403 dated 23.10.19

**S/US - Satisfactory and Unsatisfactory

* Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities. For achieving the above, suggestive list of activities to be conducted are:

Part – A

(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B

(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B

Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

Open Electives

BTEC-901C	Credits	L	T	P	Int	Ext
Display Technologies	3	3	0	0	40	60

Course Objective

The objective of the course is to give an overview to the students about various display technologies used in the past and present systems.

Course Outcomes

After undergoing this course students will be able to

I. Understand construction and working of CRT and CRT based display devices
II. Understand construction of various types of LEDs and their pros & cons
III. Familiarize themselves with the 3D displays used for better visualization and virtual reality applications
IV. Acquaint themselves with the recent display technologies

Unit 1: Cathode Ray Tube

Block diagram, Working, Electron gun, Electrostatic deflection, monochrome CRT monitor, Coloured CRT monitor, Advantages and disadvantages, Applications

Unit 2: Light-Emitting Diode

Working principle, Colours and materials, RGB LEDs, Organic light-emitting diodes (OLEDs), Advantages and Disadvantages of LEDs, Applications

Unit 3: Liquid Crystal Displays

Construction and Working Principle of LCD Display, Advantages & disadvantages, Applications, Numeric and alphanumeric displays, Dot matrix displays

Unit 4: 3D Display Technologies

Linear Time invariant Systems and their properties. Differential equation & Block diagram representation, Impulse response, Convolution integral, Frequency response (Transfer Function), Fourier transforms analysis.

Unit 5:Recent Technologies

Electronic Paper (E-Ink) Displays, Plasma Displays, Working principles of touch screens

Recommended Material Source

1. Wikipedia
2. YouTube
3. Google Search

Note: At least one question must be set from each unit/course outcome

BTEC-902C	Credits	L	T	P	Int	Ext
Sensors and Transducers	3	3	0	0	40	60

Course Objective

The course will introduce the students to various sensors and transducers used for the measurement of various physical quantities.

Course Outcomes:

After undergoing this course, students will be able to

I. Understand the principle and requirements of sensing and transduction.
II. Acquire knowledge of various resistive and inductive transducers and sensors.
III. Have understanding of various capacitive and thermal sensors.
IV. Understand fundamentals of various magnetic sensors and other miscellaneous sensors.

Unit 1: Introduction

Definition, Principle of sensing & transduction, Difference between sensors and transducers, Classification of transducers, Basic requirement of transducers, Characteristics of transducers: Static characteristics, Dynamic characteristics; Mathematical model of transducer: Zero, first order and second order transducers, Response to impulse, step, ramp and sinusoidal inputs

Unit 2: Mechanical and Electromechanical Sensors

Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity. Strain gauge: Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature, adhesive, rosettes. Inductive sensor: material, construction and output input relationship of common types- Reluctance change type, Mutual inductance change type, transformer action type, Magneto-strictive type, Ferromagnetic plunger type; LVDT: Construction, material, output input relationship, I/O curve; Proximity sensor.

Unit 3: Capacitive Sensors

Variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type, calculation of sensitivity; Stretched diaphragm type: microphone, response characteristics; Piezoelectric element: piezoelectric effect, charge and voltage co-efficient, crystal model, materials, natural & synthetic type, their comparison, force & stress sensing; Ultrasonic sensors.

Unit 4: Thermal Sensors

Material expansion type: solid, liquid, gas & vapor, Resistance change type: RTD materials, tip sensitive & stem sensitive type, thermistor material, shape, ranges and accuracy specification; Thermo-emf sensor: types, thermoelectric power, general consideration; Junction semiconductor type: IC and PTAT type.

Unit 5: Magnetic Sensors

Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, Performance characteristics. Radiation sensors: LDR, Photovoltaic cells, photodiodes, photo emissive cell, types, materials, construction, response; Geiger counters, Scintillation detectors, Pyroelectric type.

Unit 6: Miscellaneous Sensors

Introduction to smart sensors, Fiber optic sensors, Film sensors, MEMS, Nano sensors and Digital transducers.

Recommended Text and Reference Books

1. Patranabis. D, Sensors and Transducers, Prentice Hall of India,
2. H.K.P. Neubert, Instrument transducers, Oxford University press.
3. A.K. Sawhney, A Course in Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai & Co.
4. S. Renganathan ,Transducer Engineering, Allied Publishers.
5. Murthy.D.V.S, “Transducers and Instrumentation”, Prentice Hall of India,

Note: At least one question must be set from each unit/course outcome.

BTEC-903C	Credits	L	T	P	Int	Ext
Analog and Digital Communication	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to know the concepts of Analog as well as Digital Communication and understand the working of common communication techniques.

Course Outcomes

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

1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth
2. Analyze the behavior of a communication system in presence of noise
3. Investigate pulsed modulation system and analyze their system performance
4. Analyze different digital modulation schemes and can compute the bit error performance

Unit 1: Analog Communication

Review of Signals and Systems, Frequency domain representation of signals, Amplitude Modulation: Transmission and Reception of DSB, SSB and VSB, Angle Modulation, Spectral characteristics of angle modulated signals, Principles of Frequency and Pulse Modulation, Representation of FM and PM signals, Review of white noise characteristics, Noise in amplitude modulation and Angle Modulation systems, Pre-emphasis and De-emphasis.

Unit 2: Digital Communication

Analog to Digital: Need, Sampling process, Pulse Amplitude modulation and Concept of Time division multiplexing, Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation and demodulation, Adaptive and Sigma Delta Modulation, Noise considerations in PCM, Digital Multiplexers.

Unit 3: Elements of Detection Theory

Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Review of probability and random process Gaussian noise characteristics, Baseband Pulse Transmission: Inter symbol Interference and Nyquist criterion.

Unit 4: Digital Modulation Techniques

Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Recommended Books

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering'',John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication'', Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications'', 4th Edition, McGraw Hill, 2000.

Note: At least one question must be set from each unit/course outcome.

BTEC-904C	Credits	L	T	P	Int	Ext
VLSI Design	3	3	0	0	40	60

Course Objective

This course offers a profound understanding of the design of digital VLSI circuits & systems, computer aided simulation and synthesis tool for hardware design.

Course Outcomes

After undergoing this course students will be able to

1. Recognize various VHDL keywords and statements.
2. Design combinational circuits based on various design approaches in VHDL.
3. Design sequential circuits based on various design approaches in VHDL
4. Implement circuits using ROM & PLDs and know the basics of FPGA and CPLD.

Unit 1: Introduction

Introduction to Computer-aided design tools for digital systems. Hardware description languages, Introduction to VHDL, Data objects, Classes and data types, Operators, Overloading, Logical operators, Types of delays, Entity and Architecture declaration, Introduction to behavioural, Dataflow and structural models.

Unit 2: VHDL Statements

Assignment statements, Sequential statements and process, Conditional statements, Case statements, Array and loops, Resolution functions, Packages & Libraries, Concurrent statements.

Unit 3: Combinational Circuit Design

VHDL models and simulation of combinational circuits: Multiplexers, Demultiplexers, Encoders, Decoders, Code converters, Comparators, Implementation of Boolean functions.

Unit 4: Sequential Circuit Design

VHDL Models and simulation of sequential circuits: Flip-flops, Shift registers, Counters.

Unit 5: Programmable logic devices

ROM, PLAs, PALs, CPLDs and FPGA, Implementation using ROM and PLDs.

Recommended Text and Reference Books

6. Neil H. E. Weste, Principles of CMOS VLSI Design, Pearson Education.
7. Kohavi, Switching & Finite Automata Theory, TMH.
8. Samuel C. Lee, Digital Circuits and Logic Design, PHI Learning.
9. Jr. Charles H. Roth, Larry L Kinney, Fundamentals of Logic Design, Jaico Publishing House.
10. Parag K. Lala, Fault Tolerant and Fault Testable Hardware Design, BS Publications.

Note: Atleast one question must be set from each unit/course outcome.

BTEC-905C	Credits	L	T	P	Int	Ext
Mobile Computing	3	3	0	0	40	60

Course Objective

The Objective of this course for is to provide the students in-depth knowledge and understanding of mobile computing infrastructure, principles, technologies, and applications in different domains.

Course Outcomes

After undergoing this course, students will be able to

1. Understand the basic concepts of mobile computing, components and its applications.
2. Acquire knowledge of the concepts of mobile hardware and operating system.
3. Develop understanding of mobile internet and wireless technologies.
4. Know about the architecture and techniques for mobile application development.

Unit 1: Overview of mobile computing

Introduction to mobile computing, Basic building blocks of mobile computing based systems, Hardware and software components, Principles of mobile computing, Mobile computing devices, In-vehicle computing and fleet computing, Portable computing devices, Security issues, Limitations, Mobile computing applications: Internet of things, Smart home and office environment, Intelligent traffic control systems, Social computing techniques, Wearable computing.

Unit 2: Mobile Hardware and Operating System

Mobile device architecture and hardware, Mobile operating system, Operating system structure, Constraints and restrictions, Hardware configuration with mobile operating system, Features: Multitasking scheduling, Memory allocation, File system interface, Keypad interface, I/O interface, Protection and security, Multimedia features. Energy modelling and management: Battery models, Energy models and relative energy consumption of components, Dynamic Voltage and Frequency Scaling (DVFS), Power modes, Cooperative energy conservation. Case study: Android, iOS.

Unit 3: Overview of Mobile Internet and Wireless Technologies

Overview of mobile internet protocol: MIP. Mobile internet protocol version 6: MIPv6. Wireless application protocols: WAP Architecture and protocol suite. Bluetooth: Architecture, network, protocols. Overview of wireless LAN protocols: Wi-Fi, WiMAX – 802.16.

Unit 4: Mobile Application Development

Architecture of mobile software applications, Introduction to mobile development frameworks and tools, Workflow for mobile application development, Techniques for composing applications: Java, Brew, Windows CE, Symbian, WAP, Android, Location information, GIS, Location information modeling, Utilizing location based services with mobile applications, Localization and internationalization, Techniques and tools for design and development of applications in Android.

Recommended Text and Reference Books

6. J. Schiller, Mobile Communications, Addison-Wesley.
7. Raj Pandya, Mobile & Personal Communication: Systems and Services, Wiley.
8. Asoke k Talukder & Roopa R Yavagal, Mobile Computing: Technology, Application & Service Creation, Tata Mc Graw Hill.
9. Anubhav Pradhan, Anil V Deshpande, Mobile Apps Development, Wiley.
10. Jeff McWherter, Scott Gowell, Professional Mobile Application Development, John Wiley & Sons.

Note: At least one question must be set from each unit/course outcome.

BTEC-906C	Credits	L	T	P	Int	Ext
Digital Signal Processing	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to know the concepts of Digital Signal Processing and understand the commonly used digital filters and systems.

Course Outcomes

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

1. Represent signals mathematically in continuous and discrete time and frequency domain
2. Get the response of an LSI system to different signals
3. Design of different types of digital filters for various applications

Unit 1: Discrete Time Signals

Elementary Discrete time sequences and systems; Representation of signals on orthogonal basis; Sampling and reconstruction of signals; Discrete systems attributes, Basic elements of digital signal processing such as convolution, correlation and autocorrelation, Concepts of stability, causality, linearity, difference equations. Implementation of Discrete Time Systems, Linear Periodic and Circular convolution, Z-Transform, Inverse Z-Transform methods, Properties of Z-Transform.

Unit 2: LSI Systems

Analysis of LSI systems, Frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) with their properties, Inverse DFT and FFT methods, Goertzel Algorithm.

Unit 3: Digital filters Design

Structures of realization of discrete time system, direct form, Cascade form, parallel form and lattice structure of FIR and IIR systems. Time Invariant and Bilinear Transformation Methods, Rectangular, Hamming and Hanning Window methods, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low pass, Band pass, Band stop and High pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Matched Z-Transformation, Analog and Digital Transformation in the Frequency Domain. Finite Precision Effects: Fixed point and Floating point representations, Effect of round off noise in digital filters, Limit cycles.

Unit 4: Introduction to Multirate signal processing and DSP processors

Concepts of Multirate Signal Processing, need and significance, Applications of DSP, Limitations of Analog signal processing, Advantages of Digital signal processing, Architectures of ADSP and TMS (C6XXX) series of processor.

Recommended Books

1. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH, 2001.
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
4. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
5. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
6. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

Note: At least one question must be set from each unit/course outcome.

BTEC-907C	Credits	L	T	P	Int	Ext
Introduction to Big Data	3	3	0	0	40	60

Course Objectives

This course deals with knowledge of fundamentals, architecture and concepts for better understanding of Introduction of Big Data.

Course Outcomes

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

5. Understand the Evolution and basics of Big Data.
6. Understand the Architecture of Hadoop with its file system and its Programming.
7. Explain the Advanced analytical theory and methods.
8. Describe the challenges in handling streaming data from the real world.

Unit 1 - Evolution & Introduction to Big data

Best Practices for Big data Analytics, Big data characteristics, Validating - The Promotion of the Value of Big Data, Big Data Use Cases, Characteristics of Big Data Applications, Perception and Quantification of Value, Understanding Big Data Storage.

Unit 2 - A General Overview of High Performance Architecture

HDFS, Map Reduce and YARN - Map Reduce Programming Model. Big Data Overview Analysis of data at Rest- Hadoop analytics: Limitations of existing distributing systems, Hadoop Approach, Hadoop Architecture, Distributed file system: HDFS and GPFS, Internals of Hadoop MR engine, Hadoop cluster components, Hadoop Ecosystem, Evaluation criteria for distributed Map Reduce runtimes, Enterprise-grade Hadoop Deployment, Hadoop Implementation

Unit 3 - Advanced Analytical Theory and Methods

Overview of Clustering - K-means, Use Cases, Overview of the Method, Determining the Number of Clusters, Clustering, Classification, Segmentation, Linear regression, ML Search: Indexing and Indexing Techniques, Create inverted index using JAQL, Data Explorer Bundling Hadoop job: Application, Diagnostics, Reasons to Choose and Cautions, Classification: Decision Trees, Overview of a Decision Tree, The General Algorithm - Decision Tree Algorithms, Evaluating a Decision Tree

Unit 4 - Real time analytics

Introduction to streams computing, Challenges/limitations of conventional Systems, Solving a real time analytics problem using conventional system, Challenges to be solved - scalability, thread pooling, etc., Understanding the challenges in handling streaming data from the real world and how to address those using stream computing, Benefits of stream computing in Big Data world, Realtime Analytics Platform (RTAP),Real Time Sentiment Analysis.

Recommended Books

5. Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, by Chris Eaton, Paul Zikopoulos, Wiley Publication 2015.
6. Big Data Analytics: Turning Big Data into Big Money By Frank J. Ohlhorst, McGraw Hill 2012.
7. Ethics of Big Data: Balancing Risk and Innovation By Kord Davis, 2011.
8. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends, By Michael Minelli, Michele Chambers, Ambiga Dhiraj, Wiley Publication 2013.

Note: At least one question must be set from each unit/course outcome.

BTEC-908C	Credits	L	T	P	Int	Ext
Wireless Sensor Networks	3	3	0	0	40	60

Course Objective

This course aims at imparting the knowledge of Wireless Sensor Networks (WSN) basics, diverse topologies & routing techniques; along with latest simulative/designing tools for their implementation.

Course Outcomes

After undergoing this course students will be able to

V. Understand concepts related to wireless sensor networks & various application areas of WSN.
VI. Be familiar with various concepts of WSN topology control.
VII. Learn concepts of routing & various protocols used in WSN.
VIII. Be acquainted with different platforms for design and implement of WSN.

Unit 1: Introduction to Wireless Sensor Networks

Constraints and challenges of sensor networks, Emerging technologies for wireless sensor networks, Node architecture, Hardware components overview, Energy consumption of Sensor nodes, Dynamic energy and power management on system level, Optimization goals and figures of merit, QOS, Energy efficiency, Scalability, Robustness, Advantages of sensor networks, Sensor network applications.

Unit 2: Topology Control

Location driven, Connectivity driven, Geographic Adaptive Fidelity (GAF) and Geographic Random Forwarding.

Unit 3: WSN Protocols

Physical layer design, Transceiver design, MAC protocols for WSN, Low duty cycle protocols & wakeup concepts, Mediation device protocol, Wakeup radio concepts, Address & name management, Assignment of MAC addresses, Routing protocols, Energy efficient routing, Geographic routing.

Unit 4: WSN Tools

Sensor-node hardware, Berkeley motes, Introduction of different simulators/emulators for designing of WSN networks, MATLAB designing.

Recommended Text and Reference Books

4. Holger Karl & Andreas Willig, Protocols & Architectures for Wireless Sensor Networks, John Wiley.
5. Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks - An Information Processing Approach, Elsevier.
6. Waltenegus Dargie & Christian Poellabauer, Fundamentals of Wireless Sensor Networks - Theory and Practice, John Wiley and Sons.

Note: At least one question must be set from each unit/course outcome.

BTEC-909C	Credits	L	T	P	Int	Ext
Internet of Things	3	3	0	0	40	60

Course Objective:

This course will enable the students to understand the concepts of IoT technology, its hardware and software constituents, various design and development issues.

Course Outcomes:

After undergoing this course students will be able to

V. Understand basics of IoT Technology and its applications in various domains.
VI. Have knowledge of IoT Hardware, devices and architectural designs.
VII. Have understanding of the IoT softwares, programming frameworks and development techniques.
VIII. Learn about Security, interoperability issues, challenges, solutions and vision of the IoT with supporting technologies.

Unit 1: Basics of IoT Technology and its Applications

Introduction and History of IoT, Basic building blocks of IoT, Functional blocks, Standards considerations, Applications: Home automation, Industry applications, Surveillance applications, Other IoT applications, Overview of communication and networking technologies in IoT.

Unit 2: IoT Hardware and Architecture

IoT architecture outline, Physical and logical design of IoT, Service Oriented Architecture, API Oriented Architecture, IoT Sensors, Wearable Electronics, Standard Devices, IoT Actuators, IoT Resource Management, Data Management and Analytics.

Unit 3: Software and Development Techniques for IoTs

Introduction to IoT Programming frameworks, IoT development using Python programming environment, Introduction to various IoT tools, Techniques for development of applications through IoT tools, Development of sensor based application through embedded system platforms, Implementing IoT concepts using Python.

Unit 4: Security and Interoperability

IoT reliability, security and privacy issues, Understanding the risks, Modes of attack, Identity protection, Tools for achieving security, Interoperability and its need.

Unit 5: IoT Challenges and Vision

Design challenges, Development challenges, Other challenges and solutions for IoT, Vision of IoT, Introduction and use of supporting technologies in IoT: Cloud computing, FOG computing, Virtualization on embedded boards, Micro virtual machines (MicroVMs), Cloud-assisted cyber-physical systems (CPS).

Recommended Text and Reference Books

6. R K Buyya, V Dastjerdi, Internet of Things, Principles and Paradigms, Morgan Kaufmann Imprint of Elsevier.
7. P Vaher, Learning Internet of Things, PACKT Publishing.
8. O Vermesan, P Friess, Internet of Things- From Research and Innovation to Market Deployment, River Publishers.
9. Vijay Madisetti, Arshdeep Bahga, Internet of Things: A Hands-On Approach, Universities Press.
10. W Dargie, C Poellabauer, Fundamentals of Wireless Sensor Networks: Theory and Practice, John Wiley & Sons.

Note: At least one question must be set from each unit/course outcome.

BTEC-910C	Credits	L	T	P	Int	Ext
Wireless Communication	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Wireless communication using suitable mathematical models.

Course Outcomes

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

1.Understand the basic elements of Cellular Radio Systems and its design

2.Learn about the concepts Digital communication through fading multipath channels

3.Understand various Multiple Access techniques for Wireless communication

4.Know about the Wireless standards and systems

Unit 1: Elements of Cellular Radio Systems Design:

Basic cellular system, Performance criteria, Components and Operation of cellular systems, Planning a cellular system, Analog & Digital cellular systems, Concept of frequency reuse channels, Co-channel interference, Reduction factor, desired C/I for a normal case in an omni directional antenna system, Cell splitting.

Unit 2: Digital Communication through fading multipath channels:

Fading channels and their characteristics- Channel modelling, Digital signalling over a frequency non selective slowly fading channel. Concept of diversity branches and signal paths. Combining methods: Selective diversity combining, Switched combining, Maximal ratio combining, Equal gain combining.

Unit 3: Multiple Access Techniques for Wireless Communications:

Introduction, Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access, Space Division Multiple Access (SDMA), Packet Radio Protocols; Pure ALOHA, Slotted ALOHA.

Unit 4: Wireless Systems & Standards: AMPS and ETACS, United states digital cellular (IS- 54 & IS 136), IEEE Standards, Global system for Mobile (GSM): Services, Features, System Architecture and Channel Types, Frame Structure for GSM, Speech Processing in GSM, GPRS/EDGE specifications and features. 3G systems: UMTS & CDMA 2000 standards and specifications. CDMA Digital standard (IS 95): Frequency and Channel specifications, Forward CDMA Channel, Reverse CDMA Channel, Wireless Cable Television.

Unit 5: Evolution of Communication Generations: Introduction to Bluetooth, Zigbee, LTE-Advance systems, 4G & 5G Mobile techniques and Emerging technologies.

Recommended Books:

1. T.S. Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Pearson Education Asia, 2010.

2. William C Y Lee, Mobile Cellular Telecommunications, 2nd Edition, MGH, 2004.

3. Raj Pandya, ―Mobile and Personal Communication systems and services‖, Prentice Hall of India, 2001.

4. Wireless and Digital Communications; Dr. Kamilo Feher (PHI), 1998.

Note: At least one question must be set from each unit/course outcome.

BTEC-911C	Credits	L	T	P	Int	Ext
WLAN and Security	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to Wireless Local Area Network (WLAN) and security.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Develop an understanding WLAN and its architecture
2. Understand the gap between wired and wireless networks
3. Build the knowledge of security building blocks which enable them to solve the problems of designing security solutions in wireless networks.
4. Learn the wireless LAN authentication protocols in detail, and enhance the skills of configuring a secure wireless network.

Unit 1: Fundamentals of Wireless Communication - Fundamentals of Wireless Communication, Advantages, Limitations and Applications, Wireless Media, Infrared Modulation Techniques, DSSS and FHSS, Multiple access technique: TDMA, CDMA, FDMA, CSMA, OFDMA, Frequency Spectrum, Radio and Infrared Frequency Spectrum

Unit 2: Wireless local area networks (WLAN) - Introduction, Types of WLANs, WLAN Equipment, WLAN topologies and Technologies, IEEE 802.11 WLAN: Architecture, Physical Layer Standards.

Unit 3: WLAN Medium access control - Challenges for the MAC, MAC Access Modes and Timing, Contention-Based Access Using the DCF, Fragmentation and Reassembly, Frame Format, Encapsulation of Higher-Layer Protocols Within 802.11, Contention-Based Data Service

Unit 4: WLAN Framing - General frame format, Frame Control field, Format of individual frame types: Control frames, Data frames, Management frames, Types of Management Frames Management Frame fields, Frame Transmission and Association and Authentication States.

Unit 5: Wireless Security - Wireless Application Protocol, WAP Security, Authentication, Integrity, Confidentiality, Security Issues with Wireless Transport Layer Security (WTLS), Wireless LAN Security, Access Point Security, Work Station Security, Safeguarding Wireless LAN's.

Unit 6: WLAN Security and Authentication - Cryptographic Background to WEP, WEP Cryptographic Operations, Problems with WEP, The Extensible Authentication Protocol, EAP Packet Format, EAP Requests and Responses, EAP Success and Failure, EAP Exchange, 802.1x: Network Port Authentication, 802.1x Architecture and Nomenclature, EAPOL Encapsulation, 802.1x Exchange, 802.1x on Wireless LANs

Recommended Books:

1. Eldad Perahia and Robert Stacey, Next Generation Wireless LANs: 802.11n and 802.11ac (2nd Edition), Cambridge University Press 2010.
2. Matthew S. Gast, O'Reilly, 802.11 Wireless Networks: The Definitive Guide, 2nd Edition, Media, Inc.1998.
3. Pejman Roshan, Jonathan Leary, 802.11 Wireless LAN Fundamentals, Cisco Press, 2014.
4. Brijendra Singh, Network Security and Management, 3rd edition, PHI 2000.

Note: At least one question must be set from each unit/course outcome.

BTEC-912C	Credits	L	T	P	Int	Ext
Satellite Communication	3	3	0	0	40	60

Course Objective

This is one of the fundamental courses meant to understand the important concepts related to the understanding of Satellite Communication.

Course Outcomes

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

6. Visualize the architecture of satellite systems as a means of high speed, high range communication system.
7. State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
8. Understand phenomena in satellite communication.
9. Understand the general link design equation and the concepts related to it.
10. Learn about VSAT system and its applications

Unit 1 - Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication, Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.

Unit 2 - Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Altitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc.

Unit 3 - Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Doppler frequency shift phenomena and expression for Doppler shift. Received signal power equations.

Unit 4 - Satellite Link Design: Introduction, General Link Design Equations, System Noise Temperature C/N and G/T Ratio, Atmospheric and Ionospheric Effects on Link design, Uplink design, Complete Link Design, Interference effects on Complete Link design, Earth Station Parameters.

Unit 5 - VSAT Satellite Systems: Introduction, Network Architecture, VSAT Earth Station, VSAT Applications.

Recommended Books:

1. Trimothy Pratt, Charles W. Bostian, —Satellite Communications||, John Wiley & Sons, 1986.
2. Dr. D.C. Aggarwal, —Satellite Communications||, Khanna Publishers, 2001.
3. Dennis Roddy, —Satellite Communications||, McGraw Hill, 1996.

Note: At least one question must be set from each unit/course outcome.

BTEC-913C	Credits	L	T	P	Int	Ext
Artificial Intelligence	3	3	0	0	40	60

Course Objective

The main objective of this course is to enlighten the students with the basic fundamentals of Artificial Intelligence Networks, Systems, Methods and parameters.

Course Outcomes

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

- Learn about the basic understanding of Artificial Intelligent system
- explain about various types of Artificial Neural Networks & their models
- describe Artificial Neural networks methods, operation and parameters
- explore Neural Network MATLAB Toolbox

Unit 1 - Introduction

Approaches to intelligent control, Architecture of intelligent control, Linguistic reasoning, Rulebase, Knowledge representation.

Unit 2 - Artificial Neural Networks

Biological neuron, Artificial Neural Network (ANN), Mathematical Models, McCulloch Neural Model, Perceptron, Adaline and Madaline, Learning & Training in ANN, Hopfield Neural Network, Self Organizing Networks, Recurrent Networks, Associative memories.

Unit 3 - Fuzzy Logic System

Crisp Vs Fuzzy set theory, Membership functions, Fuzzy set operations, Fuzzy rules, Mamdani and Sugeno fuzzy inference systems, Defuzzification methods.

Unit 4 - ANN Methods and Parameters

Introduction and biological background of GA, String Encoding of chromosomes, Selection methods, Single & multi-point crossover operation, Mutation, Adjustment of strategy parameters such as Population size, Mutation & Crossover probabilities.

Unit 5 - Fuzzy Logic MATLAB Toolbox

Fuzzy Logic Toolbox, Neural Network Toolbox, FLS for Antilock Breaking System (ABS), GA in route planning for Travelling Sales Person, Time-Series forecasting using ANN.

Recommended Books

1. Jacek M. Zurada - Introduction to Artificial Neural Systems, PWS Publishing Company 1995.
2. S N Sivanandam, S N Deepa - Principles of Soft Computing, Wiley Publications, 2007.
3. John Yen, Reza Langari - Fuzzy Logic Intelligence, Control, and Information, Pearson 1998.

Note: At least one question must be set from each unit/course outcome.

BTEC-914C	Credits	L	T	P	Int	Ext
Engineering Materials	3	3	0	0	40	60

Course Objectives

The objective of this course is to provide basic understanding of engineering materials and their mechanical, electrical and magnetic properties.

Course Outcomes

After undergoing this course students will be able to

I. Understand the importance of engineering materials, their classification and types of defects involved in engineering materials.
II. Analyze the various kinds of mechanical properties such as Stiffness, Ductility, Brittleness, Resilience etc. of materials.
III. Analyze the properties and applications of electrical and magnetic materials and factors affecting electrical resistance of materials.
IV. Understand about selection of engineering materials for a particular application on the basis of their properties.

Unit 1: Structure of solids

Classification of engineering materials, Structure - property relationship in engineering materials, Crystalline and non- Crystalline materials. Defects: Point, Line and Surface defects.

Unit 2: Mechanical properties of materials

Elastic, Inelastic and Viscoelastic materials, Yielding and yield strength, Stiffness, Ductility, Brittleness, Resilience, Toughness, True stress – true strain relationship, Hardness, Shrinkage, Plastic deformation by twinning and slip, Movement of dislocation, Critical shear stress, Strengthening mechanism and creep

Unit 3: Electrical and Magnetic Materials

Factors affecting electrical resistance of materials, Superconductivity, Properties and applications of conducting materials, Properties and applications of semi-conducting materials, Properties and applications of insulating materials; Magnetic materials, soft and hard magnetic materials and their applications; Smart materials: sensors and actuators, piezoelectric, magnetostrictive and electrostatic materials

Unit 4: Materials Selection

Overview of properties of engineering materials, Material selection in design based on properties covering timber, aluminium, glass, polymers and ceramics

Recommended text and Reference Books

1. W.D. Callister, Materials Science and Engineering; John Wiley & Sons
2. W.F. Smith, Principles of Materials Science and Engineering: An Introduction; Tata Mc-GrawHill
3. Raghavan, Introduction to Materials Science and Engineering; PHI
4. S. O. Kasap, Principles of Electronic Engineering Materials; Tata Mc-Graw Hill
5. L. H. Van Vlack, Elements of Material Science and Engineering; Thomas Press

Note: Atleast one question must be set from each unit/course outcome.

BTEC-915C	Credits	L	T	P	Int	Ext
AI & Machine Learning	3	3	0	0	40	60

Course Objective

This course deals with knowledge and background required for better understanding of Artificial Intelligence (AI) and Machine Learning and its issues, challenges and fundamentals. The course actually possesses the ability to apply AI techniques to solve problems of Game Playing, Expert Systems and Machine Learning.

Course Outcomes

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

1. To learn the difference between optimal reasoning Vs human like reasoning
2. To understand the notions of state space representation, exhaustive search, heuristic search along with the time and space complexities
3. To learn different knowledge representation techniques
4. To understand the applications of AI namely, Game Playing, Theorem Proving, Expert Systems, Machine Learning and Natural Language Processing

Unit -1: Foundations of AI and Intelligent Agents: What is AI, History of AI, Strong and weak AI, The State of the Art. Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Unit-2: Basic AI Concepts and Machine Learning: Boolean Algebra, Expert Systems, Configuration of Device, Introduction to SWI Prolog, Installing prolog, Introduction to Fuzzy Logic, Basic of ML, Colour Selection Algorithm.

Unit-3: Solving Problems by Searching: Problem -Solving Agents, Example Problems, Searching for Solutions, uniformed search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.

Unit-4: Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information, The Internet Shopping World.

Unit-5: Learning from Examples: Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, The Theory of Learning, Regression and Classification with Learner Models, Nonparametric Models, Support Vector Machines, Ensemble Learning, Practical Machine Learning.

Recommended Books

1. Artificial Intelligence A Modern Approach, Stuart J. Russell & Peter Norvig -Pearson.
2. Artificial Intelligence, Elaine Rich, Kevin Knight & Shivashankar B Nair -McGraw Hill Education.
3. Nils J. Nilsson: Principles of Artificial Intelligence, Elsevier
4. T. Hastie, R. Tibshirani, J. Friedman ---The Elements of Statistical Learning, 2e, 2008.
5. C. Bishop --- Pattern Recognition and Machine Learning. 2e 2010.
6. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
7. E. Alpaydin, —Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
8. S. Marsland, —Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

Note: At least one question must be set from each unit/course outcome.

BTEC-916C	Credits	L	T	P	Int	Ext
Microwave-Photonics	3	3	0	0	40	60

Course Objective To enable the students to know about different devices/components used in microwave, and optical engineering and along with methods to develop different state-of-the-art integrated Microwave-Photonics system/networks.

Course Outcomes

At the end of this course students will be aware of:

1. Different Microwave devices/components, their working, and uses in Microwave-related industries.
2. Different Optical devices/components, their working and uses in Photonics-related industries.
3. Different Integrated Microwave and Photonics technology and their future perspectives.

Basics of Microwave Engineering: Antenna, Antenna types: Directional Antennas, Omnidirectional Antenna, Microwave Antenna, Microwave Tubes: Klystron Amplifier, Reflex Klystron, Magnetron, Travelling Wave Tube (TWT), Microwaves Transistors: (Bipolar, FET), Transferred Electron Devices (Gunn diode), Microwave Amplification by Stimulated Emission of Radiation (MASER), Phased array Antenna, Time delay arrangements for phased array antennas, Transmission lines-coaxial cables, waveguides, Microstrip, Optical fiber, and comparison of losses. Beamforming and scanning techniques, RADAR.

Basics of Photonic Engineering: TIR, Fiber Types (SMF, MMF, GRIN), Fiber Losses, Dispersion: Chromatic dispersion, Intermodal dispersion, Non-Linear Effects, LASERS, LEDs, Photodetectors, Power Budget, Optical Amplifiers: SOA, EDFA, Optical delay lines: fiber optical delay lines, square root cascade delay lines.

Microwave-Photonics Systems: Radio over Fiber System, Free Space Optics, Inter-satellite Optical Fiber Communication System, Photonics-Radar System, Role of Microwave-Photonics in Navigation and Surveillance Applications, Passive Optical Networks.

Recommended Books

1. Senior J. Optical Fiber Communications, Principles & Practice, PHI 1985.
2. Keiser G., Optical Fiber Communication, Mc Graw-hill 2008.
3. Govind P. Agrawal, Fiber Optics Communication Systems, John Wiley & Sons (Asia) Pvt. Ltd 1998.
4. Djafar K. Mynbeav, Fiber-Optics Communications Technology, Pearson 2001.
5. M. Kulkarni, Microwave and Radar Engineering, Umesh Publications, 5th Edition, 2018.
6. Jordan E.C., Electromagnetics and radiating systems, PHI 1995.
7. J.D. Krauss, Antenna Theory, McGraw Hill 1999.
8. C. A. Balanis, Antenna Theory, John Wiley & sons 4th Edition 2016.

Note: At least one question must be set from each unit/course outcome.

BTEC-917C	Credits	L	T	P	Int	Ext
Soft Computing	3	3	0	0	40	60

Course Objectives

The main objective of this course is to enlighten the students with the basic fundamentals and concepts of Soft Computing and Algorithms.

Course Outcomes

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

1. Understand the concepts of Soft Computing and Algorithms involved there-in
2. Understand Genetic Algorithms with its operators and applications
3. Learn about the Neural Network models and its applications

4. Describe the Fuzzy systems and Swarm Intelligence

Unit 1: Introduction - What is soft computing? Differences between soft computing and hard computing, Soft Computing constituents, Methods in soft computing, Applications of Soft Computing. Introduction to Genetic Algorithms- Introduction to Genetic Algorithms (GA), Representation, Operators in GA, Fitness function, population, building block hypothesis and schema theorem.; Genetic algorithms operators- methods of selection, crossover and mutation, simple GA(SGA), other types of GA, generation gap, steady state GA, Applications of GA

Unit 2: Neural Networks- Concept, biological neural system,. Evolution of neural network, McCullochPitts neuron model, activation functions, feed forward and feedback networks, learning rules - Hebbian, Delta, Perceptron learning and Windrow-Hoff,winner-take-all. Supervised learning- Perceptron learning, single layer/multilayer perceptron, Adaptive resonance architecture, applications of neural networks to pattern recognition systems such as character recognition, face recognition, Application of Neural networks in Image processing.

Unit 3: Fuzzy systems - Basic Definition and Terminology, Set-theoretic operations, Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rules & Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making; Neuro- fuzzy modeling- Adaptive Neuro-Fuzzy Inference Systems, Coactive Neuro-Fuzzy Modeling, Classification and Regression Trees, Data Clustering Algorithms, Rule base Structure Identification.

Unit 4: Swarm Intelligence- What is swarm intelligence? Various animal behavior which have been used as examples, ant colony optimization, swarm intelligence in bees, flocks of birds, shoals of fish, ant-based routing, particle swarm optimization

Recommended Books:

1. S.N. Shivanandam, Principle of soft computing, Wiley. ISBN13: 9788126527410, 2011.
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing”, PrenticeHall of India, 2003.
3. George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic-Theory and Applications”, Prentice Hall, 1995.
4. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Pearson Edn., 2003.
5. Mitchell Melanie, “An Introduction to Genetic Algorithm”, Prentice Hall, 1998.
6. David E. Goldberg, Genetic Algorithms in Search, Optimization & Machine Learning, Addison Wesley, 1997.

Note: At least one question must be set from each unit/course outcome.

BTEC-918C	Credits	L	T	P	Int	Ext
Biomedical Instrumentation	3	3	0	0	40	60

Course Objectives

This course emphasizes on the fundamental principles of various biomedical equipments, different biological signals, their acquisition and measurement. The course will be beneficial to the students to explore biomedical field for pursuing advanced education or career.

Course Outcomes

After undergoing this course, students will be able to

V. Learn about the different types of transducers and electrodes for biomedical applications.
VI. Acquire knowledge of the various biomedical measurement devices with their electrical safety standards.
VII. Comprehend the knowledge of cardio vascular and respiratory system measurements.
VIII. Get acquainted with the medical imaging techniques and assisting & therapeutic equipments.

Unit 1: Transducers and Electrodes

Different types of transducer and their selection for biomedical applications; Inductive, Capacitive, Piezoelectric transducers. Thermistors: Radiation & chemical thermometry, Electrode theory and different types of electrodes, Internal electrodes, Micro electrodes, Polarization, Electrode behaviour, Electrode-skin interface.

Unit 2: Origin of Biopotentials

Electric activity of cells, Neuron resting potential, Nernst equation: ECG, EEG, EMG, Source of these potentials, Generation of signals, Recording. Electrical Safety in medical environment: Micro shock and macro shock hazards, Basic approaches to shock protection, Electrical safety standards.

Unit 3: Cardio Vascular and Respiratory System Measurements

Measurement of blood pressure, Cardiac output and cardiac rate. Respiratory mechanism, Measurement of gas volume, Flow rate, Carbon dioxide and oxygen concentration in exhaled air, Respiration controller.

Unit 4: Medical Imaging

Principles and applications of radiography, CAT scan, MRI, Ultrasonography, Nuclear medicine, Angiography, Fluoroscopy. Bio-effects of microwaves: Interaction of microwaves with biological systems, Diathermy, Biological hazards of microwaves as well as low frequencies.

Unit 5: Assisting and Therapeutic Devices

Cardiac pacemakers, Electrical stimulators, Defibrillators, Haemodialysis, Ventilators.

Recommended text and Reference Books

5. John G. Webster, Medical Instrumentation: Applications and Design, John Wiley and Sons.
6. C.Rajarao and S.K.Guha, Principles of Medical Electronics and Biomedical Instrumentation, Universities Press.
7. R.S.Khandpur, Handbook of Biomedical Instrumentation, TMH.
8. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, PHI.

Note: At least one question must be set from each unit/course outcome

BTEC-919C	Credits	L	T	P	Int	Ext
Robotics and Automation	3	3	0	0	40	60

Course Objective

The main objective of this course is to enlighten the students with the basic fundamentals of Robotics, Robotic Transformation, Simulation and programming along with the Embedded systems in Robotics so that they will be able to design the robots which would facilitate to the humans to solve the real world problems.

Course Outcomes

After undergoing this course, students will be able

1. To understand basic concept of robotics.
2. To analyze Instrumentation systems and their applications to various
3. To know about the differential motion, add statics in robotics
4. To know about the various path planning techniques.
5. To know about the dynamics and control in robotics industries.

Unit 1 - Basic Concepts

Brief history-Types of Robot-Technology-Robot classifications and specifications-Design and control issues-Various manipulators-Sensors-work cell-Programming languages.

Unit 2 - Direct and Inverse Kinematics

Mathematical representation of Robots-Position and orientation- Homogeneous Transformation-Various Joints-Representation using the Denavit Hattenberg parameters-Degrees of freedom-Direct Kinematics- Inverse kinematics-SCARA robots-Solvability-Solution Methods-Closed form solution.

Unit 3- Manipulator Differential Motion And Statics

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints-Inverse-Wrist and arm singularity-Static Analysis-Force and moment Balance.

Unit 4 - Path Planning

Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique-Parametric Descriptions-Straight line and circular paths-Position and orientation planning.

UNIT 5 - Robotics System Design

Running Code on Microcontroller-Voltage, Current and power-ARM Cortex M-Software Design-Battery and Voltage Regulation-GPIO-Interfacing Input and Output-DC Motors-Timers-Bluetooth Low Energy.

Recommended Books:

6. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
7. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education,2009.
8. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-HillSingapore, 1996.
9. Jonathan W. Valvano, Embedded Systems: Introduction to Robotics, First Edition,2019
10. TI Robotic System Design Lab-RSLK (https://university.ti.com/en/faculty/ti-robotics-system-learning-kit/ti-robotics-system-learning-kit)

Note: At least one question must be set from each unit/course outcome.

BTEC-920C	Credits	L	T	P	Int	Ext
Deep Learning	3	3	0	0	40	60

Course Objective: To make the student understand the concepts of Deep Learning

Course Outcomes

After undergoing this course, the students will be able to:

6. Comprehend the advancements in learning techniques
7. Compare and explain various deep learning architectures and algorithms.
8. Demonstrate the applications of Convolution Networks
9. Apply Recurrent Network for Sequence Modelling
10. Deploy the Deep Generative Models

UNIT 1: Machine Learning Basics: Learning, Under-fitting, Overfitting, Estimators, Bias, Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning, Unsupervised Learning and Stochastic Gradient Decent.

UNIT 2: Deep Feedforward Network: Feed-forward Networks, Gradient-based Learning, Hidden Units, Architecture Design, Computational Graphs, Back-Propagation, Regularization, Parameter Penalties, Data Augmentation, Multi-task Learning, Bagging, Dropout and Adversarial Training and Optimization.

UNIT 3: Convolution Networks: Convolution Operation, Pooling, Basic Convolution Function, Convolution Algorithm, Unsupervised Features and Neuroscientific for convolution Network.

UNIT 4: Sequence Modelling: Recurrent Neural Networks (RNNs), Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Network, Recursive Neural Networks and Echo State networks.

UNIT 5: Deep Generative Models: Boltzmann Machines, Restricted Boltzmann Machines, Deep Belief Networks, Deep Boltzmann Machines, Sigmoid Belief Networks, Directed Generative Net, Drawing Samples from Auto –encoders.

Recommended Books:

1. Goodfellow L., Bengio Y. and Courville A., Deep Learning, MIT Press (2016).
2. Patterson J. and Gibson A., Deep Learning: A Practitioner's Approach, O'Reilly (2017), 1st ed.
3. Haykin S., Neural Network and Machine Learning, Prentice Hall Pearson (2009), 3rd ed.
4. Geron A., Hands-on Machine Learning with Sci-kit and TensorFlow, O'Reilly Media (2017)

Note: At least one question must be set from each unit/course outcome.