Department of
ELECTRONICS AND COMMUNICATION ENGINEERING

4 Years B.Tech Degree Programme

REGULATION & SYLLABUS 2017

Choice Based Credit System
Outcome Based Assessment

SEMESTER-V& VI

AUTONOMOUS

Accredited by NBA

Accredited by NAAC with 'A' Grade (3.28 out of 4.00 CGPA)

GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

Affiliated to UGC New Delhi & Biju Patnaik University of Technology, Odisha

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates of the program will have a successful career of mechanical engineering by imparting Mechanical Engineering concepts and practical knowledge.

PEO2: Graduates of the program will pursue higher education and research in the field of mechanical engineering.

PEO3: Graduates of the program will exhibit Scientific and Engineering expertise and perform as a Professional Entrepreneur.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Ability to apply the acquired Mechanical Engineering knowledge for the development of composite materials for societal application.

PSO 2: Ability to implement the learned principles of Mechanical Engineering to analyze, evaluate and create more advanced mechanical systems by using state-of-art facilities.

PROGRAMME OUTCOMES (POs)

PO-1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO-2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3. Design / Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO- 4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO- 5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO- 6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO- 7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO- 8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO- 9. Individual and team work: Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11. Project management and finance: Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

V SEMESTER [THIRD YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1	PC	BECPC5010	Analog Communication	3	1	0	4	A
2	PC	BECPC5020	Signals and Systems	3	0	0	3	A
3	PC	BECPC5030	Electromagnetic Engineering	3	0	0	3	A
4	PE	BECPE5041	Fiber Optics and Optoelectronic Devices	3	0	0	3	A
		BECPE5042	Advanced Electronic Circuits					
		BECPE5043	Electronic Devices and Modeling					
		BELPE5044	Power Electronics					
5	OE	BCSOE5051	Operating Systems	3	0	0	3	A
		BCSOE5052	Computer Architecture and Organization					
		BEIOE5053	Sensors and Transducers					
6	BS/ HS	BBSBS5061	Optimization in Engineering	3	0	0	3	A
		BMSHS5062	Organizational Behaviour					
PRACTICAL / SESSIONAL								
7	PC	BECPC5110	Analog Communication Techniques Laboratory	0	0	2	1	-
8	PC	BECPC5120	Signals and Systems Laboratory	0	0	2	1	-
9	PC	BECPC5130	Electromagnetic Engineering Laboratory	0	0	2	1	-
10	PC	BECPC5150	*Skill Development Project and Hands on Training	0	0	2	1	-
11	PC	BECPC5170	^Summer Internship-I	0	0	2	1	-
TOTAL				**18**	**1**	**10**	**24**	

*College should conduct at least one NSDC program under this category.

^ Four (4) weeks duration summer internship either in industry or in an R&D organization, including educational institutes with excellent research culture. The student is expected to submit a formal report at the end of the programme.

VI SEMESTER [THIRD YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1	PC	BECPC6010	Digital Communication	3	1	0	4	A
2	PC	BECPC6020	Digital Signal Processing	3	0	0	3	A
3	PC	BECPC6030	Digital VLSI Design	3	0	0	3	A
4	PE	BECPE6041	Information Theory and Coding	3	0	0	3	A
		BECPE6042	Nano Electronics					
		BECPE6043	Biomedical Electronics					
		BECPE6044	Internet of Things					
5	OE	BCSOE6051	Computer Network and Data Communication	3	0	0	3	A
		BBSOE6052	Numerical Methods					
		BMEOE6053	Robotics and Robot Applications					
6	BS/ HS	BBSBS5061	Optimization in Engineering	3	0	0	3	A
		BMSHS5062	Organizational Behaviour					
PRACTICAL / SESSIONAL								
7	PC	BECPC6110	Digital Communication Techniques Laboratory	0	0	2	1	-
8	PC	BECPC6120	Digital Signal Processing Laboratory	0	0	2	1	-
9	PC	BECPC6130	Digital VLSI Design Laboratory	0	0	2	1	-
10	PC	BECPC6140	Advanced Laboratory-I	0	0	2	1	-
11	HS	BTPHS6160	#Soft Skill and Employability Skill	0	0	2	1	-
TOTAL				**18**	**1**	**10**	**24**	

#To be conducted by the Training & Placement Department of the College.

Subject Code	**ANALOG COMMUNICATION**	L	T	P	C	QP
BCPC5010	Course Educational Objective	3	1	0	4	

CEO1: Introduce the concepts of analogue communication systems

CEO 2: To equip students with various issues related to analogue communication such as modulation, demodulation, transmitters and receivers and noise performance.

Pre-Requisites (If any) – Signal & System

Course Outcomes

CO1 Define different types of signal and its mathematical analysis.

CO2 Describe energy and power spectral density of the signal.

CO3 Illustrate various methods of generation and detection of amplitude modulation and angle modulation.

CO4 Distinguish between different types of modulation techniques based on bandwidth Occupied and power transmitted

CO5 Summarize different pulse modulation techniques.

CO6 Evaluate the basic equation of AM &FM . Compare the performance of communication system by evaluating the figure of merit for different schemes of modulation.

Unit:1 **(8hrs)**

SIGNALS AND SPECTRA: An Overview of Electronic Communication Systems, Signaland its Properties, Fourier series Expansion and its Use, The Fourier Transform & its Properties.

RANDOM VARIABLES AND PROCESSES: Probability, Random variables, UsefulProbability Density functions, Useful Properties and Certain Application Issues.

Unit:2 **(15hrs)**

AMPLITUDE MODULATION SYSTEMS: Introductionto amplitude Modulation, Double Side Band with Carrier DSB-C, DSB-SC, Single Sideband Modulation (SSB), VSB

ANGLE MODULATION: General equation ofAngle Modulation, Modulation index, Types of FM , FM Modulators and Demodulators.

PULSE MODULATION : Analogto Digital (Noisy Channel and Role of Repeater), Sampling Theorem, Nyquist Rate, Generation & Detection of Pulse Amplitude Modulation and Concept of Time division multiplexing/PAM, PWM:

Unit:3 **(10hrs)**

MATHEMATICAL REPRESENTATION OF NOISE: Sources of Noise,Frequency-domain Representation of Noise, Superposition of Noises, Linear Filtering of Noise: Ideal LPF,RC-Filter, Band pass filter..

NOISE IN AMPLITUDE MODULATION SYSTEM: Introduction to Amplitude demodulation, Single Sideband Suppressed Carrier (SSB-SC), Double Sideband Suppressed Carrier (DSB-SC), Double Sideband with Carrier (DSB-C).calculation of figure of merit.

Unit:4 **(7hrs)**

NOISE IN FREQUENCY MODULATION SYSTEM: An FM Receiving System,Calculation of Signal to Noise Ratio, Comparison of FM and AM, Pre emphasis and De-emphasis and SNR Improvement.

Teaching Method(s): Chalk & Board/ PPT/ Demonstration/Video lectures.

Text Books

1.Principles of Communication System, H. Taub, D. L Schilling, G. Saha, Tata McGraw Hill, 3rd Edition, 2008.

2.Modern Digital and Analog Communication Systems, B.P. Lathi, Zhi Ding, Oxford University Press, 4th edition 2010

3. Communication System ,Sanjay Sharma,2nd edition

Reference Books

Communication System Engineering, MasoudSalehi, John G. Proakis, PHI, Pearson Education, Second Edition 2002.

Analog Communication, V. Chandra Sekar, Oxford University Press 2010.

Communication Systems S.Haykin, john Wiley& sons 4th edition 2001.

R.P Singh and S.D Sapre, *COMMUNICATION SYSTEMS Analog & Digital*, 2nded. New Delhi, India: Tata McGraw Hill Education Private Limited, 2009

SIGNALS & SYSTEM

Subject Code	L	T	P	C	QP
BECPE5020	3	0	0	3	

Pre -Requisite: Fundamental Mathematics, Analytical Skill

Course Educational Objective

CEO1: Familiar about basic signal and system modeling concept and understanding of the fundamental properties of linear systems and time invariant system.

CEO2: To provide a thorough understand of continuous-time signals and discrete-time signals

CEO3: To analyze application of understand linear time-invariant systems theory and applications for continuous and discrete time signal in time and frequency domain.

CEO4: Knowledge about the concept of signal processing, representation and its application in various domains.

Course Outcome

At the end of the course students will be able to

CO1 Represent, Classify Signals & Systems

CO2 Perform mathematical operation on both continuous &discrete signal.

CO3 Apply the concept of Fourier series, Fourier transform, Laplace transform & Z transform to continuous & discrete signal

CO4 Analyze the stability of systems, response of the LTI system

CO5 Evaluate the response of the system using time domain, s-domain & Z-domain.

CO6 Establish the relation between the input and output using different block diagrams.

MODULE-01 **12 Hours**

CONTINUOUS TIME SIGNALS AND SYSTEMS

Elementary signals, Classification of continuous time signal-Deterministic and Nondeterministic signal, Periodic and Non periodic signal ,Even and Odd signal, Energy and Power signal, Causal and Non causal signal, Mathematical Operations on continuous time signals, Continuous Time System-Block diagram representation ,classification –static and dynamic, time variant and time invariant ,linear and nonlinear ,stable and unstable, Interconnection of continuous time system. Convolution and Unit step response.

DISCRETE TIME SIGNALS AND SYSTEMS

Representation of discrete time signal, Elementary signals, Classification of discrete time signal-Deterministic and Nondeterministic signal, Periodic and Non periodic signal ,Even and Odd signal, Energy and Power signal, Causal and Non causal signal, Mathematical Operations on discrete time signals, Discrete Time System-Block diagram representation ,Classification –static and dynamic, time variant and time invariant ,linear and nonlinear ,stable and unstable, Interconnection of discrete time system. Convolution and Unit step response

MODULE- 02 **12 Hours**

FOURIER SERIES AND FOURIER TRANSFORM OF CONTINUOUS TIME SIGNALS

Trigonometric form of Fourier series , Properties of Fourier series, Gibbs Phenomenon. Fourier Transform –unit impulse signal, unit step signal, Signumfunction ,exponential signal, sinusoidal and cosinusoidal signal, properties of Fourier transform.

FOURIER SERIES AND FOURIER TRANSFORM OF DISCRTETE TIME SIGNALS

Definition of discrete time Fourier series, properties of discrete time Fourier series, Fourier transform-Definition, Inverse discrete time Fourier transform, properties of discrete time Fourier transform

MODULE: 03 **8 Hours**

LAPLACE TRANSFORM

Introduction, Region of Convergence, Properties of Laplace Transform, Inverse Laplace Transform-partial fraction method, convolution theorem, Transfer function and impulse Response, Pole-zero location, stability in S-domain.

MODULE 4: **10 Hours**

Z-TRANSFORM

Introduction, Region of Convergence, Properties of Z-Transform, Inverse Z-Transform-Long division method, partial fraction method, , Transfer function and impulse Response, Pole-zero location, causality and stability . Unilateral Z-transform, Time shifting property, Application of Unilateral Z-transform

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books

1**.** Signals and Systems – A NagoorKani, TMH.

2. Digital Signal Processing – Principles, Algorithms and Applications, John. G. Proakis and

Dimitris. G. Manolakis, 4th Edition, Pearson.

3. Signals and Systems –A. Anand Kumar, 3rd Edition PHI Learning Pvt. Ltd

Ref. Books

1. Signals and Systems - P. Ramakrishna. Rao, TMH**.**

2.Signals and Systems, Chi-Tsong Chen, Oxford

3. Principles of Signal Processing and Linear Systems,B.P. Lathi, Oxford.

4. Signal & Systems by Tarun Kumar Rawat, Oxford University Press.

CO-PO Mapping

Electromagnetics engineering

Subject Code	L	T	P	C	QP
BECPC5030	**3**	**1**	**0**	**4**	**A**

Pre -Requisite: Engineering Mathematics-II

Course Educational Objective

CEO1: To provide the basic idea of static electric and magnetic field

CEO2: To analyze the static electric and magnetic in different medium

CEO3: To ascertain the idea about time varying electric and magnetic waves

CEO4: To provide the practical implementation of transmission line and waveguides

Course Outcome

CO1 Relate the vector calculus with static electric and magnetic field.

CO2 Solve simple electrostatic and magnetostatics problems

CO3 Analyze the time varying electric and magnetic fields .

CO4 Solve the problems using Maxwell Formulae and analyze moving charges on Magnetic fields.

CO5 Ascertain the plane wave and its propagation in different medium

CO6 Provide the basic idea of transmission line as well as wave guides and their implementation of day to day life

MODULE:1 **(10 Hours)**

Cartesian , Cylindrical and Spherical Coordinate Systems; Scalar and Vector Fields; Line, Surface and Volume Integrals.

Coulomb's Law ; The Electric Field Intensity; Electric Flux Density and Electric Flux; Gauss's Law; Divergence of Electric Flux Density; Point Form of Gauss's Law; The Divergence Theorem; The Potential Gradient; Energy Density; Poisson's and Laplace's Equations.

Ampere's Magnetic Circuital Law and its Applications; Curl of H; Stokes's Theorem; Divergence of B; Energy Stored in the Magnetic Field.

MODULE:2 **(8 Hours)**

The Continuity Equation; Faraday's Law of Electromagnetic Induction; Conduction Current; Point Form of Ohm's Law, Convention Current; The Displacement Current.

Maxwell's Equations in Differential Form; Maxwell's Equations in Integral Form; Maxwell's Equations for Sinusoidal Variation of Fields with Time; Boundary Conditions; The Retarded Potential; The Poynting Vector; Poynting Vector for Fields Varying Sinusoidally with Time.

MODULE:3 **(8 Hours**

Solution of the One-Dimension Wave Equation; Solutions of Wave Equation for Sinusoidally Time-Varying Fields; Polarization of Uniform Plane Waves; Fields on the Surface of a Perfect Conductor; Reflection of a Uniform Plane Wave Incident Normally on

a Perfect Conductor and at the Interference of Two Dielectric Regions; The Standing Wave Ratio; Oblique Incidence of a Plane Wave at the Boundary between Two Regions; Oblique Incidence of a Plane Wave on a Flat Perfect Conductor and at the Boundary between Two Perfect Dielectric Regions.

MODULE:4 **(8 Hours)**

Types of Two-Conductor Transmission Lines; Circuit Model of an Uniform Two-Conductor Transmission Line; The Uniform Ideal Transmission Live; Wave Reflection at a Discontinuity in an Ideal Transmission Line; Matching of Transmission Lines with Load. Formulation of Field Equations; Wave Types; the Parallel-Plate Waveguide; the Rectangular Waveguide.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

REFERENCE BOOKS

Engineering Electronics , William H. Hayt& J. Buck , Tata McGraw Hill Publishing Company Ltd., New Delhi, 7th Edition, 2006.

Electronics, Joseph A. Edminister , adapted by Vishnu Priye, Tata McGraw Hill Publishing Company Ltd., New Delhi , 2nd Edition.

Fundamentals of Electromagnetic for Engineering , First Impression , N. N. Rao, Pearson Education , New Delhi ,2009.

Fields and Waves in Communication Electronics, Simon Ramo, Wiley Publication, 3rdEdition , 2007.

Electromagnetic Field Theory ,Bhag Sing Guru , Cambridge Publication , 3rd Edition, 2011.

FIBER OPTICS & OPTOELECTRONICS DEVICES

Subject Code	L	T	P	C	QP
BECPE 5041	**3**	**0**	**0**	**3**	

Pre -Requisite:A basic course on Electromagnetic Theory& physics.

Course Educational Objective

CEO1:The objective of this course is for students to learn modern experimental techniques in optics and photonics in the context of learning about optical fiber communication systems.

CEO2:To expose the students to the basics of signal propagation through optical fibers, fiber impairments, components and devices and system design.

Course Outcome

CO1 Recognize and classify the structures of Optical fiber and types.

CO2 Understand basic system design of fiber optic communication link and fundamental theory of fiber optics.

CO3 Discuss the channel impairments like losses and dispersion.

CO4 Analyze various coupling losses.

CO5 Classify the Optical sources and detectors and to discuss their principle.

CO6 Familiar with Design considerations of fiber optic systems.

UNIT:1 **(12 Hrs)**

Introduction to Optical Fiber Communications: Evolution of Fiber Optic Systems, Elements of an Optical Fiber Transmission Link.

Optical Fibers: Structures, Ray propagation through SI and GI fiber, V -number, Pulse broadening- multipath dispersion and material dispersion, Wave propagation in rectangular and circular waveguides, attenuation (absorption, scattering and bending)

UNIT:2 **(11Hrs)**

Fiber fabrication, Double crucible method, Fiber optic cables, Connector and splice. Losses during coupling between source to fiber, fiber to fiber. Schemes for coupling improvement.

Optoelectronic Sources, LED, ILD, light source materials, Radiation Pattern, modulation capability.

UNIT:3 **(10Hrs)**

Optoelectronic Detector, PIN AND APD, Responsivity, Band width, Detector noise equivalent circuit and SNR calculation.

WDM components-couplers, isolators, circulators, filters

UNIT:4 **(10 Hrs)**

Optical Amplifier : Semiconductor optical Amplifier and Erbium Doped Fiber Amplifier.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books1. G. Keiser, Optical Fiber Communications (4/e), TMH, 2008.

2. A. Ghatak& K. Thygarajan, Introduction to Fiber Optics, Cambridge, 1999

3.Fiber optics and Optoelectronics, R.P.Khare, Oxford University Press.

Reference Books

1.MMK. Liu, Principles and Applications of Optical Communications, TMH, 2010.

2. G.P. Agrawal, Fiber Optic Communication Systems, (3/e), Wiley, 2002.

3. J. Gowar, Optical Communication Systems, (2/e), PHI, 2001.

Subject Code	**ADVANCEDELECTRONICS CIRCUITS**	L	T	P	C	QP
BECPE5043		3	0	0	3	

Pre-Requisites (If any) – A student should have basic idea on analog electronics circuits

Course Educational Objective

CEO1: To understand the basic concept of analogue device and its application.

CEO2: To get a complete knowledge of multivibrator and its principle.

Course Outcomes

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

CO1 Demonstrate understanding of circuit analysis for bipolar and MOS circuits

CO2 Demonstrate knowledge and understanding of the requirements for and operation of sensor interface circuits, power supplies, data converters and oscillators

CO3 Understand the key concepts of feedback in electronic circuits

CO4 Understand the concepts of filter design, and be able to demonstrate knowledge and understanding of how to design a simple filter using operational amplifiers

Unit:1 **(10hrs)**

. **1: Active Filters :**Active Filters, Frequency response of Major Active filters, First order low-pass Butterworth filter: Filter Design, Frequency Scaling, Second-order low-pass Butterworth filter: First-order high-pass Butterworth filter, Second-order high- pass Butterworth filter, Band-pass filters: Wide band-pass Filter, Narrow Band-Pass Filter, Band-reject filters: Wide Band-Reject Filter, Narrow Band-Reject Filter, All- Pass filter.

Oscillators: Oscillator Principles, Oscillator Types, Quadrature Oscillator, Saw tooth wave generator, Voltage-controlled oscillator.

Comparators: Comparators: basic comparator, zero-crossing detector, Schmitt trigger, comparator characteristics, limitations of Op-Amp as comparators, voltage limiters.

Unit:2 **(14hrs)**

.**1. BistableMultivibrator:**BistableMultivibrator, fixed-bias bistablemultivibrator, Loading, self-biased transistor binary, commutating capacitors, triggering the binary, Unsymmetrical Triggering of the bistablemultivibrator, Triggering Unsymmetrical through a Unilateral Device, Symmetrical Triggering, Triggering of a Bistable Multi Symmetrically without the Use of Auxiliary Diodes, Schmitt Trigger Circuit (Emitter-coupled BistableMultivibrator).

2. Monostable and AstableMultivibrator: Monostable Multivibrator, Gate Width of a Collector-Coupled Monostable Multivibrator, Waveforms of the Collector-Coupled Monostable Multivibrator, Emitter-Coupled Monostable Multivibrator, Triggering of the Monostable Multivibrator. Astable Collector-Coupled Multivibrator, Emitter- coupled astablemultivibrator.

Unit:3 **(10hrs)**

1. Negative Resistance Switching Devices: Voltage Controllable Negative resistance devices, Tunnel Diode operation and characteristics, Monostable Astable, Bistable circuits using tunnel diode, Voltage controlled Negative Resistance Switching Circuits.

2. Voltage and Current Time Base Generators: Time-Base Generators, General features of a

Time-base signal, Methods of generating a voltage time-base waveform, Exponential sweep circuit, Miller and bootstrap time base generators- Basic principles, Transistor miller time base generator, Transistor bootstrap time base generator, Current Time-Base Generators, A Simple Current sweep, Linearity Correction through adjustment of driving waveform, Transistor current time base generator.

Unit:4 **(10hrs)**

1. Specialized IC Applications: IC 555 Timer: IC 555 Timer as a Monostable Multivibrator and its applications, IC 555 Timer as AstableMultivibrator and its applications. Phase Locked Loop: Operating principle of PLL, Phase detectors, Exclusive-OR phase detector, Monolithic phase detector, Instrumentation Amplifier and its applications.

Teaching Method(s): **Chalk & Board/ PPT/Video LECTURE**

Text Books:

Pulse, Digital and switching Waveforms, Second Edition - Jacob Millman, Herbert TaubandMothiki S Prakash Rao (TMH Publication).

OP-Amps and Linear Integrated Circuits- Ramakant A. Gayakwad (PHI Publication).

Pulse, Switching, and Digital Circuits, David A. Bell, Oxford University Press

Pulse & Digital Circuits by K.Venkata Rao, K Rama Sudha & G Manmadha Rao, Pearson Education, 2010. (Selected portions)

Reference Books:

OP-Amps and Linear Integrated Circuits - Robert F. Coughlin, Frederick F. Driscoll (Pearson Education Publication).

Pulse and Digital Circuits by A. Anand Kumar,PHI

Subject Code	**ELECTRONICS DEVICES AND MODELING**	L	T	P	C	QP
BECPE5044		3	0	0	3	

Pre-Requisites (If any) – Basic knowledge of electronic components and laws such as KCL, KVL, etc.

Course Educational Objective

CEO1: To understand the performance of modern electronic devices using BSIMModel and compact modeling tools.

CEO2: To know the principles of SPICE3, HSPICE and PSPICE Models .

Course Outcomes

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

CO1 To apply the principles of semiconductors devices

CO2 To apply basic principle of diode and understand its second and third approximation.

CO3 To analyze and study the various special purpose diodes such as zener diode, schottky diode, varactor diode and photo diode.

CO4 To analyze the rectifier circuits, clippers and clamper circuits using diodes.

CO5 To study and analyze the various AC models.

Unit:1 **(10hrs)**

.**1.PN–Junction Diode and Schottky Diode:** DC Current-Voltage Characteristics,Static Model, Large-Signal Model, Small-Signal Model, Schottky Diode and its Implementation in SPICE2, Temperature and Area Effects on the Diode Model Parameters, SPICE3, HSPICE and PSPICE Models

Unit:2 **(10hrs)**

.**1. Metal-Oxide-Semiconductor Transistor (MOST):** Structure and OperatingRegions of the MOST, LEVEL1 Static Model, LEVEL2 Static Model, LEVEL1 and LEVEL2 Large-Signal Model, LEVEL3 Static Model, LEVEL3 Large-Signal Model, The Effect of Series Resistances, Small-Signal Models, The Effect of Temperature.

Unit:3 **(10hrs)**

1.BJT Parameter Measurements: Introduction, Input and Model Parameters, ParameterMeasurements.

2.MOST Parameter Measurements: LEVEL1 Model Parameters, LEVEL2 Model(Long-Channel) Parameters, LEVEL2 Model (Short-Channel) Parameters, LEVEL3 Model Parameters, Measurements of Capacitance, BSIM Model Parameter Extraction **Noise and Distortions:** Noise, Distortion.

Unit:4 **(10hrs)**

Bipolar Junction Transistor (BJT): Transistor Conversions and Symbols, Ebers-Moll Static Model, Ebers-Moll Large-Signal Model, Ebers-Moll Small-Signal Model, Gummel-Poon Static Model, Gummel-Poon Large-Signal Model, Gummel-Poon Small-Signal Model, Temperature and Area Effects on the BJT Model Parameters, Power BJT Model, SPICE3, HSPICE and PSPICE Models

Teaching Method(s): Chalk & Board/ PPT/Video Lectures/ Invited Guest lecture/ Demonstration.

Textbooks

Semiconductor Device Modeling with SPICE, Giuseppe Massobrio and Paolo Antognetti, Tata McGraw-Hill Education, 2nd edition, 2010.

Semiconductor Physics and Devices, 3rd Edition, Donald A. Neamen, Tata McGraw Hill Publishing Company Limited, New Delhi.

Reference Books

1.Device Electronics for Integrated Circuits, Richard S. Muller, Theodore I. Kamins, and Mansun Chan, John Wiley and Sons, New York, 3rd edn.,2003.

2. Devices for Integrated Circuits: Silicon and III-V Compound Semiconductors, H. Craig Casey, John Wiley, New York, 1999.

3.Semiconductor Material and Device Characterization, Dieter K. Schroder, John Wiley and Sons, New York, 1990.

4.Fundamentals of Semiconductor Devices, M.K. Achuthan and K.N. Bhatt, Tata McGraw Hill Publishing Company Limited, New Delhi.

Title of the subject

Subject Code		L	T	P	C	QP
BCSOE5051	**Operating System**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite:

Course Educational Objective

CEO1: To understand main components of OS and their working

CEO2: To study the operations performed by OS as a resource manager

CEO3: To understand the different scheduling policies of OS

CEO4: To understand the different memory management techniques

CEO5: To understand process concurrency and synchronization

CEO6: To understand the concepts of input/ output, storage and file management

CEO7: To study different OS and compare their features.

Course Outcome

CO1 Apply optimization techniques for the improvement of system performance.

CO2 Ability to understand the synchronous and asynchronous communication mechanisms in their respective OS.

CO3 Learn about minimization of turnaround time, waiting time and response time and also maximization of throughput with keeping CPU as busy as possible.

CO4 Ability to compare the different OS

UNIT:1 **(10 Hours)**

Operating System Introduction: Operating Systems Objectives and functions, Computer System Architecture, OS Structure, OS Operations, Evolution of Operating Systems - Simple Batch, Multi programmed, time shared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems, Special - Purpose Systems, Operating System services, user OS Interface, System Calls, Types of System Calls, System Programs, Opening System Design and Implementation, OS Structure, Virtual machines.

UNIT:2 **(12 Hours)**

Process and CPU Scheduling - Process concepts - The Process, Process State, Process Control Block, Threads, Process Scheduling - Scheduling Queues, Schedulers, Context Switch, Preemptive Scheduling, Dispatcher, Scheduling Criteria, Scheduling algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Thread scheduling, Case studies: Linux, Windows.Process Coordination - Process Synchronization, The Critical section Problem, Peterson's solution, Synchronization Hardware, Semaphores, and Classic Problems of Synchronization, Monitors, Case Studies: Linux, Windows.

UNIT:3 **(14 Hours)**

Memory Management and Virtual Memory - Logical & physical Address Space, Swapping, Contiguous Allocation, Paging, Structure of Page Table. Segmentation, Segmentation with Paging, Virtual Memory, Demand Paging, Performance of Demanding Paging, Page

Replacement Page Replacement Algorithms, Allocation of Frames, Thrashing.

Deadlocks - System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery from Deadlock.

UNIT:4 **(14 Hours)**

File System Interface - The Concept of a File, Access methods, Directory Structure, File System Mounting, File Sharing, Protection, File System Implementation - File System Structure, File System Implementation, Allocation methods, Free-space Management, Directory Implementation, Efficiency and Performance.Mass Storage Structure - Overview of Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap space Management.

Protection - System Protection, Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Implementation of Access Matrix, Access Control, Revocation of Access Rights, Capability-Based Systems, Language-Based Protection.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books

1. Operating System Principles, Abraham Silberchatz, Peter B. Galvin, Greg Gagne 8th Edition, Wiley Student Edition.

2. Operating systems - Internals and Design Principles, W. Stallings, 6th Edition, Pearson.

Ref. Books :

Modern Operating Systems, Andrew S Tanenbaum 3rd Edition PHI.

Operating Systems A concept - based Approach, 2nd Edition, D. M. Dhamdhere, TMH.

Principles of Operating Systems, B. L. Stuart, Cengage learning, India Edition.

Operating Systems, A. S. Godbole, 2nd Edition, TMH

An Introduction to Operating Systems, P.C.P. Bhatt, PHI.

Operating Systems, S, Haldar and A. A. Arvind, Pearson Education.

Operating Systems, R. Elmasri, A. G. Carrick and D. Levine, Mc Graw Hill.

Operating Systems in depth, T. W. Doeppner, Wiley.

Title of the subject

Subject Code		L	T	P	C	QP
BCSOE5052	**Computer Architecture and Organization**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite:

Course Educational Objective

CEO1: Identify the functional units in a digital computer system,

CEO2: Distinguish between the various ISA styles, trace the execution sequence of an instruction through the processor,

CEO3: Compare different approaches used for implementing a functional unit and evaluate different computer systems based on performance metrics.

Course Outcome

CO1 Can get the idea of how the instruction is executed in the processor.

CO2 Able to know how the instructions are routed in the processor.

CO3 Solve the given problem for arithmetic operation on various type of binary numbers.

CO4 Can get the idea of how the data and insruction fetched or stored from or to the memory and have the idea of I/O interfaces.

UNIT:1 **(12 Hours)**

FUNDAMENTALS OF A COMPUTER SYSTEM: Functional Units of a Digital Computer ,Hardware ,Software Interface,Translation from a High Level Language to the Hardware Language Instruction Set Architecture, Styles and features, RISC and CISC Architectures ,Performance Metrics ,Amdahl's Law ,Case Studies of ISA.

UNIT:2 **(12 Hours)**

BASIC PROCESSING UNIT: Components of the Processor,Datapath and Control – Execution of a Complete Instruction,Hardwired and Micro programmed Control, Instruction Level Parallelism, Basic Concepts of Pipelining, Pipelined Implementation of Datapath and Contro, Hazards,Structural, Data and Control Hazards,Exception handling. Parallelism and Multiprocessor Architecture ,Flynn's Classification, UMA, NUMA, Distributed Memory Architecture. Array and Vector Processor.

UNIT:3 **(12 Hours)**

ARITHMETIC FOR COMPUTERS: Addition and Subtraction, Fast Adders,Binary Multiplication, Fast Multiplicatiom, Binary Division and its techniques,Floating Point Numbers,Representation, Arithmetic Operations.

UNIT:4 **(12 Hours)**

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books:

Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, "Computer Organization and Embedded Systems", Sixth Edition, Tata McGraw Hill, 2012.

David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Fourth Edition, Morgan Kaufmann / Elsevier, 2009.

Kai Hwang and F.A. Briggs, "Computer Architecture and Parallel Processing", McGraw Hill.

Ref. Books:

M. Morris Mano, "Computer System Architecture", PHI

William Stallings, "Computer Organization and Architecture – Designing for Performance", Sixth Edition, Pearson Education, 2003.

John P. Hayes, "Computer Architecture and Organization", Third Edition, Tata McGraw Hill, 1998.

John L. Hennessey and David A. Patterson, "Computer Architecture – A Quantitative Approach", Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.

Title of the subject

Subject Code	L	T	P	C	QP
SENSOR & TRANSDUCER	**3**	**0**	**0**	**3**	

Pre -Requisite:measurement system, calibration.

Course Educational Objective

CEO1: To understanding thestructuraland functionalprinciplesofsensors andtransducers usedfor variousphysical and nonelectric quantities.

CEO2: To forge the students about the use of sensors andtransducersto measurethe physical quantities.

CEO3: To explain theprinciplesof operationof thesensorparameters andgenerators.

Course Outcome

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

CO1 Understand how measurement systems are designed, calibrated, characterised, and analysed.

CO2 Illustrate the fundamental principles of various types of sensors including thermal, mechanical, electrical, electromechanical and optical sensors.

CO3 Use appropriate measurement methods for engineering tasks and scientific researches.

CO4 Calibrate and measurement uncertainty.

CO5 Design, construction, and execution of a instrumentation measurement projects.

CO6 Develop an awareness and understanding of the crucial part that measurement plays in industrial and scientific activities.

UNIT I: **10 Hours**

Elements of a general measurement system: systematic characteristics, statistical characteristics, calibration, Dynamic characteristics of

measurement systems, transfer functions of typical sensing elements, step and frequency response of first and second order elements, and dynamic error in measurement systems.

UNIT II: **10 Hours**

Sensing elements: **Resistive sensing elements**: potentiometers, Resistance Temperature Detector (RTD), thermistors, strain gages. **Capacitive sensing elements**: variable separation, area and dielectric. **Inductive sensing elements**: variable reluctance and LVDT displacement sensors.

UNIT III: **12 Hours**

Signal Conditioning Elements: Deflection bridges, design of resistive and reactive bridges, push-pull configuration for improvement of linearity and sensitivity

Amplifiers: Operational amplifiers-ideal and non-ideal performances, inverting, non-inverting and differential amplifiers, instrumentation amplifier, filters. A.C. carrier systems, phase

sensitive demodulators and its applications in instrumentation.

UNIT IV: **8 Hours**

Thermoelectric sensing elements: laws, thermocouple characteristics, installation problems, cold junction compensation.

IC temperature sensor Elastic sensing elements: Bourdon tube, bellows, and diaphragms for pressure sensing, force and torquemeasurement.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text book:

1. Principles of Measurement Systems, J.P. Bentley, Pearson Education, New Delhi, 3rd Edition 2007.

2. Introduction to Measurement and Instrumentation, A.K. Ghosh , PHI Learning, 3rd Edition,2009.

3. Transducers and Instrumentation, D.V.S. Murthy, PHI Learning, New Delhi, 2009.

Reference books:

1. Measurement Systems Application and Design, E.O. Doeblin, McGraw-Hill, 4th Edition.

2. Instrumentation for Engineering Measurements, J.W. Dally, W.F. Riley and K.G. McConnel , John Wiley, NY,2nd edition 2003.

3. Industrial Instrumentation, T.R. Padmanabhan, Springer, London, 2000.

Subject Code	Name of the Subject	L	T	P	C	QP
BMGHS5052	**Organisational Behaviour**	3	0	0	3	A

Course Educational Objectives

CEO1 To develop an understanding of the behaviour of individuals and groups inside organizations

CEO2 To enhance skills in understanding and appreciating individuals, interpersonal, and group process for increased effectiveness both within and outside of organizations.

CEO3 To develop theoretical and practical insights and problem-solving capabilities for effectively managing the organizational processes.

Course Outcomes

CO1 Define, explain and illustrate a range of organizational behaviour theories.

CO2 Analyse the behaviour of individuals and groups in organizations in terms of organizational behaviour theories, models and concepts.

CO3 To explain group dynamics and demonstrate skills required for working in groups (team building)

CO4 Communicate effectively in oral and written forms about organizational behaviour theories and their application using appropriate concepts, logic and rhetorical conventions.

CO5 To explain organizational culture and describe its dimensions and to examine various organizational designs

SYLLABUS

Unit – I **[14Hrs]**

Fundamentals of OB: Definition, scope and importance of OB, Relationship between OB and the individual, Evolution of OB, Theoretical framework (cognitive), behaviouristic and social cognitive), Limitations of OB.

Attitude: Importance of attitude in an organization, Right Attitude, Components of attitude, Relationship between behaviour and attitude, Developing Emotional intelligence at the workplace, Job attitude, Barriers to changing attitudes.

Personality and values: Definition and importance of Personality for performance, The Myers-Briggs Type Indicator and The Big Five personality model, Significant personality traits suitable to the workplace (personality and job – fit theory), Personality Tests and their practical applications.

Perception: Meaning and concept of perception, Factors influencing perception, Selective perception, Attribution theory, Perceptual process, Social perception (stereotyping and halo effect).

Motivation: Definition & Concept of Motive & Motivation, The Content Theories of Motivation (Maslow's Need Hierarchy & Herzberg's Two Factor model Theory), The Process Theories (Vroom's expectancy Theory & Porter Lawler model), Contemporary Theories – Equity Theory of Work Motivation.

Unit - II **[12Hrs]**

Foundations of Group Behaviour: The Meaning of Group & Group behaviour & Group Dynamics, Types of Groups, The Five – Stage Model of Group Development.

Managing Teams: Why Work Teams, Work Teams in Organization, Developing Work Teams, Team Effectiveness & Team Building.

Leadership: Concept of Leadership, Styles of Leadership, Trait Approach Contingency Leadership Approach, Contemporary leadership, Meaning and significance of contemporary leadership, Concept of transformations leadership, Contemporary theories of leadership, Success stories of today's Global and Indian leaders.

Unit – III **[14 Hrs]**

Organizational Culture : Meaning & Definition of Organizational Culture, creating & Sustaining Organizational Culture, Types of Culture (Strong vs. Weak Culture, Soft Vs. Hard Culture & Formal vs. Informal Culture), Creating Positive Organizational Culture, Concept of Workplace Spirituality.

Unit – IV **[8 Hrs]**

Organizational Change: Meaning, Definition & Nature of Organizational Change, Types of

Organizational Change, Forces that acts as stimulants to change.
Implementing Organizational Change : How to overcome the Resistance to Change, Approaches to managing Organizational Change, Kurt Lewin's-Three step model, Seven Stage model of Change &Kotter's Eight-Step plan for Implementing Change, Leading the Change Process, Facilitating Change, Dealing with Individual & Group Resistance, Intervention Strategies for Facilitating Organizational Change, Methods of Implementing Organizational Change, Developing a Learning Organization.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books/Reference books:

Understanding Organizational Behaviour, Parek, Oxford
Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.
Organizational Behaviour, K. Awathappa,HPH.
Organizational Behaviour, VSP Rao, Excel
Introduction to Organizational Behaviour, Moorhead, Griffin, Cengage.
Organizational Behaviour, Hitt, Miller, Colella, Wiley

Subject Code	**ANALOG COMMUNICATION LAB**	L	T	P	C	QP
BECPC 5110		**0**	**0**	**2**	**1**	

Pre -Requisite: Knowledge of electronic devices, electronic circuits is required.

Course Educational Objective

CEO1: Understand all types of analog modulation / demodulation principles such as AM, DSB-SC, FM .
CEO2: Know the use of different transmission techniques used in communication system.

Course Outcome

CO1 Design and simulate modulation and demodulation circuits such as AM, FM.

CO2 Illustrate the operation of TDM-PAM.

CO3 Examine the operation of Sample & hold circuit as PAM demodulator.

CO4 Evaluate analog modulated waveform in time /frequency domain and also find modulation index

List of Experiments

Analyze and plot the spectrum of following signals with aid of spectrum analyzer : sine wave , square wave , triangular wave, sawtooth wave of frequencies 1 KHz , 10 KHz , 50 KHz ,100 KHz , 1 MHz .

To generate of AM Modulator (DSB-C) and calculate modulation index.

Study and design of AM demodulator (DSB-C).

To generate frequency modulated signal by using FM modulator and calculate modulation index.

To generate original message by using Frequency Demodulation techniques.

To generate sampled output by using PAM.

To demonstrate Time Division Multiplexing and demultiplexing process using Pulse amplitude modulation signal.

To generate original message signal by using sample & hold circuit.

To demonstrate PPM and PWM signals.

Show the AM waveform of a sinusoidal signal in time domain and analyze its freq spectrum using MATLAB/SCILAB. Repeat the same for square, triangular and for other waveforms.

Show the FM waveform of a sinusoidal signal in time domain and analyze its freq spectrum using MATLAB/SCILAB. Repeat the same for square, triangular and for other waveforms.

Using LABVIEW software simulate AM modulation and demodulation system.

SIGNAL AND SYSTEM LABORATORY

Subject Code	L	T	P	C	QP
	0	0	2	1	

Pre -Requisite: programming skill, Basic Mathematics

Course Educational Objective(students would be able to)

CEO1: Perform various signal operation upon the signal using MATLAB.

CEO2: Get Adequate knowledge on MATLAB for various time domain and frequency domain analysis of signal.

CEO3: write the mat lab coding in of z transform, Fourier transform and Laplace transform.

CEO4: Apply the concept of MATLAB coding for various real time project

Course Outcome(students should be able to)

CO1 Familiar the matrix operation of signal used for discrete and continuous signal.

CO2 Describe matlab coding for Laplace transform, Fourier Transform ,Z transform,

CO3 Relate the concept of continuous and discrete signal in MATLAB coding.

CO4 Analyze complex mathematical function of time domain and frequency domain using Mat lab.

CO5 Design the various mathematical function and simulation model using mat lab.

CO6 Apply the concept of signal processing in real time signal presentation and analysis.

Write a MATLAB program for basic Matrix operation on signal(representation, addition, deletion, Multiplication e.t.c and various matrix representation)

Write a program to generate continuous and the discrete sequences (i) unit step (ii) unit impulse (iii) ramp (iv) exponential signal (iv) periodic sinusoidal sequences. Plot all the sequences.

Write a MATLAB programme for shifting, folding operation of signal.

Write a MATLAB program to convolve two discrete time sequences. Plot all the sequences. Verify the result by analytical calculation

Write a MATLAB program to find the autocorrelation and cross correlation of sequences.

Write a MATLAB program for z transform of a sequence.

Find the Fourier transform of a square pulse .Plot its amplitude and phase spectrum.

Write a program to find the trigonometric Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings.

Write a program to find the trigonometric and exponential Fourier series coefficients of a periodic rectangular signal. Plot the discrete spectrum of the signal.

Generate a discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.

Write a program to find the Laplace transform of a second order signal.

Generate a uniformly distributed length 1000 random sequence in the range (0, 1). Plot the histogram and the probability function for the sequence. Compute the mean and variance of the random signal.

Generate a Gaussian distributed length 1000 random sequence. Compute the mean

And variance of the random signal by a suitable method.

Write a program to generate a random sinusoidal signal and plot four possible

Realizations of the random signal.

Teaching Methods: LCD/SYSTEM / PPT/Video Lectures/Lecture by Industry Expert/MOOCS/

Text Books

Signals and Systems Primer with MATLABAlexander D. Poularikas

Ref. Books

Signals and Systems Laboratory with MATLABAlex Palamides, Anastasia Veloni

Signals and Systems: A Primer with MATLAB®Matthew N. O. Sadiku, Warsame Hassan Ali

Signals and Systems: A MATLAB A Integrated Approach

Signals, Systems, Transforms, and Digital Signal Processing with MATLAB , **Michael Corinthios**

Continuous Signals and Systems with MATLAB, Second EditionTaanElAli, Mohammad A. Karim

Electromagnetic engineering laboratory

Subject Code	L	T	P	C	QP
BECPC5130	**0**	**0**	**2**	**1**	

Course Outcome

CO1 Define the E Field and H Field

CO2 Explain the patch antenna

CO3 Demonstrate the simulation of patch antenna
CO4 Calculate the error of S--Parameter
CO5 Design and Simulate the dipole antenna
CO6 Design the dipole antenna for specified frequency

List of Experiment

Wave--Propagation in conductors and dielectric using HFSS.

To design a rectangular patch antenna using HFSS.

To design circular patch angina using HFSS.

To design and simulate Probe Feed patch antenna using HFSS.

To design slot coupled patch antenna using HFSS.

To design the CPW feed patch antenna by using HFSS.

To design and simulate a Half--Wave Dipole Antenna using HFSS.

To design and simulate a Half--Wave Dipole Antenna which will resonate at 2.4GHz frequency.

Subject Code	**DIGITAL COMMUNICATION**	L	T	P	C	QP
BECPC 6010		3	1	0	4	

Pre-Requisites (If any) – Basics of mathematical concepts, electronics circuits and analog communication

Course Educational Objective

CEO 1 : Understand basic elements of digital communication system

CEO 2 : Analyse the performance of modulation and demodulation techniques in various transmission environments

Course Outcomes

CO1 Explain the different blocks in digital communication system.

CO2 Employ the time & frequency domain analysis of signals in a digital communication system.

CO3 Examine & differentiate the performance of a baseband & pass band digital communication system in terms of error rate and spectral efficiency.

CO4 Design different filters.

CO5 Describe the principles of various digital modulation systems and their properties; including bandwidth, channel capacity, transmission over band limited channels, inter-symbol interference (ISI), demodulation methods, and error performance in the presence of noise.

CO6 Explain how to manage communication system resources including bandwidth and power by selecting a proper digital modulation scheme.

Unit:1 **(15 hrs)**

Digital Representation of Analog Signal -

Sampling Theorem, Signal reconstruction, Types of Sampling Techniques, applications of sampling theorem.

Quantization of Signals, Quantization error,PCM, Electrical representation of binary digits, PCM System, Companding ; Types of companding Line coding, T1 Digital System, Multiplexing T1 lines – The T2, T3 and T4 lines ;Differential PCM- Linear predicted design, Delta Modulation, and Adaptive Delta Modulation.

Noise in PCM and DM - Calculation of Quantization Noise, Output Signal Power,Thermal Noise, Output SNR in PCM, Quantization noise in Delta Modulation, output signal power, output SNR, Comparison with PCM and DM.

Unit:2 **(10 hrs)**

Digital Modulation Schemes- Generation, Transmission, Reception; Spectrum and Geometrical Representation in the Signal Space of BPSK, DPSK, QPSK, QASK, M-ary PSK, BFSK, M-ary FSK, and Minimum Shifting Keying (MSK).

Unit:3 **(7 hrs)**

Principle of Digital Data Transmission- Digital Communication Systems – Source, Line coder, Multiplexer, Regenerative repeater; Line Coding- PSD of various line codes, polar signaling, constructing a DC Null in PSD by pulse shaping, On Off signaling, Bipolar signaling; Pulse shaping – ISI and effect, Nyquist first criterion for zero ISI; Scrambling, Digital receiver and

regenerative repeaters; Equalizers, Timing extraction, Detection error,

Eye Diagram.

Unit:4 **(8 hrs)**

Data Transmission- A base band signal Receiver, Peak signal to RMS noise output voltage ratio, , calculation of optimum filter transfer function, optimum filter realization using Matched filter, Probability error of the matched filter, optimum filter realization using correlator.

Teaching Method(s): Chalk & Board/ PPT/Video Lectures

Text Books:

1. Principles of Communication Systems, H Taub, D L Schilling and G Saha, TMH Education Pvt Ltd, 4th Edition 2013.

2. An Introduction to Analog and Digital communications, Simon Haykin, Wiley Publication, 2nd edition, 2007

3. Modern Digital and Analog Communication Systems, B.P. Lathi and Z Ding, Oxford University Press, New Delhi. 4th Edition 2010.

Reference Books:

1. Digital and Analog Communication System, Leon W. Couch-II, Prentice Hall of India, Pearson Education, 6th Edition 2001.

2. Digital and Analog Communication System, K. Sam Shanmugam, Wiley India Pvt. Ltd 2006.

3. Digital Communications – Fundamentals and applications, Bernard Sklar, Pearson education Publication, 2nd Edition, 2009.

4. R N Mutagi, Digital Communication- Theory, Techniques and Applications, Oxford University Press

Subject Code	**DIGITAL SIGNAL PROCESSING**	L	T	P	C	QP
BECPC6020		3	0	0	3	

Pre -Requisite: Fundamental of Signal & System, Fundamental of Communication and Mathematics

Course Educational Objective

CEO1:To introduce discrete time signals, systems, time and frequency domain representation concepts.

CEO2: To provide a thorough understanding and working knowledge of design, implementation, analysis and comparison of digital filters for processing of discrete time signals.

CEO3: To analyze its wide application in MAT LAB as well as in audio, Image, telecommunication and real world.

CEO4: Familiar about the concept of signal processing and its application in real world.

Course Outcome

At the end of the course students will be able to

CO1 Recall the concepts of discrete signal representation, its operation and discrete time systems.

CO2 Convert the time domain signal analysis to frequency domain analysis using various transform.

CO3 Capable of understanding Digital Signal Processing Applications using z transform and DFT.

CO4 Apply Fast Fourier Transform (FFT) Algorithms for faster realization of discrete signals and systems and analyze the response of filter.

CO5 Evaluate the response of Digital filters using different techniques and obtain the frequency spectrum in frequency domain.

CO6 Design of Digital filters using window techniques, Fourier methods, frequency sampling techniques and Analog filters.

UNIT:1 **12 Hours**

The Discrete Fourier Transform: Its Properties and Applications

The Discrete Fourier Transform, Inverse Discrete Fourier Transform, the DFT as a Linear Transformation, Relationship of the DFT to z-Transforms, circular shifting, circular convolution –circle method, matrix method, DFT and IDFT method, Properties of the DFT: Linearity, circular time shift, circular frequency shift, complex conjugate, , Multiplication of Two DFTs,Circular Convolution and Parseval's relation, Filtering of Long Data Sequences-overlap save method and overlap add method.

UNIT:2 **10 Hours**

Efficient Computation of the DFT: Fast Fourier Transform Algorithms

Efficient Computation of the DFT: FFT Algorithms: Direct Computation of the DFT, Radix-2 FFT Algorithms: Decimation-In-Time (DIT), Decimation-In-Time (DIF); Applications of FFT Algorithms: Efficient Computation of the DFT of two Real Sequences, Efficient Computation of the DFT a 2N-Point Real Sequence

UNIT:3 **10 Hours**

DESIGN AND REALIZATION OF FIR FILTER

Structure for FIR Systems: Direct-Form Structure, Cascade-Form Structures, Linear Phase structure Frequency-Sampling Structures, Design of Linear-Phase FIR Filters by using Windows-Rectangular, Blackman, hamming, hanning and triangular. Design of Linear-Phase FIR Filters by the Frequency-Sampling Method

UNIT:4 **10 Hours**

DESIGN AND REALIZATION OF IIR FILTER

Structure for IIR Systems: Direct-Form Structures, Signal Flow Graphs and Transposed Structures, Cascade-Form Structures, Parallel-Form Structures, Design of IIR Filters from Analog Filters: IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation. Warping effect.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books

1.Digital Signal Processing Principles, Algorithms an d Applications, J. G. Proakis and

D. G. Manolakis, 4th Edition, Pearson.

2. Digital Signal Processing, Tarun Kumar Rawat, Oxford University Press.

3. Discrete-Time Signal Processing by A. V. Oppenheim and R. W. Schafer.

4. Digital Signal Processing in Communication Systems by Marvin E. Frerking.

Ref. Books

1.Digital Signal Processing: a Computer-Based Approach, Sanjit K. Mitra, TMH

2. Digital Signal Processing, S. Salivahan, A. Vallavraj and C. Gnanapriya, TMH.

3. Digital Signal Processing, Manson H. Hayes, Schaum's Outlines, TMH.

4. Digital Signal Processing: A Modern Introduction, Ashok K Ambardar, Cengage Learning.

5. Modern Digital Signal Processing, Roberto Cristi, Cengage Learning.

6.Digital Signal Processing: Fundamentals and Applications, Li Tan, Jean Jiang,

Academic Press, Elsevier.

7. Digital Signal Processing: A MATLAB-Based Approach,Vinay K. Ingle and John G.

Proakis, Cengage Learning.

8.Fundamentals of Digital Signal Processing using MATLAB, Robert J. Schilling and

Sandra L. Harris, Cengage Learning. PVT Ltd., 3rdEdition.

`Subject Code	**DIGITAL VLSI Design**	L	T	P	C	QP
BECPC6030		3	0	0	3	

Pre -Requisite: Fundamental of Analogue Electronic Circuit, Digital Electronics Circuit, Physical Semiconductor Devices

Course Educational Objective

CEO1:To make the students familiar with the basic concept of CMOS device and its manufacturing technology

CEO2: To have a complete knowledgeof CMOS Logic circuits and their working principle.

CEO3: To analyse the noise margin, delay and power estimationof VLSI circuits.

CEO4: To familiar with various dynamic CMOS logic styles and testing mechanism.

Course Outcome

At the end of the course students will be able to

CO1 Know the basic concepts of Semiconductor devices(MOSFETs) & fabrication processes

CO2 Understand the layout design process and VLSI Design Flow

CO3 Apply the concept of CMOS in designing static and dynamics circuits

CO4 Analyze the switching action, power dissipation & delay estimation of VLSI Circuit

CO5 Evaluate the performance of various logic circuits with CMOS

CO6 Create different combinational and sequential logic circuits & their testing techniques.

UNIT:1 **12 Hours**

1.Introduction: Historical Perspective, VLSI Design Methodologies, VLSI Design Flow, Design Hierarchy, Concept of Regularity, Modularity and Locality, VLSI Design Styles,

2. Fabrication of MOSFETs: Introduction, Fabrication Processes Flow – Basic Concepts The CMOS n-Well Process, Layout Design Rules, Stick Diagrams, Full-Customs Mask Layout Design.

3.MOS Transistor: The Metal Oxide Semiconductor (MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET),

MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry

Effects, MOSFET Capacitance.

UNIT:2 **12 Hours**

4. MOS Inverters – Static Characteristics: Introduction, Resistive-Load Inverters, Inverters with n-Type MOSFET Load, CMOS Inverter.

5.MOS Inverters – Switching Characteristics and Interconnect Effects: Introduction, Delay-Time Definitions, Calculation of Delay-Times, Estimation of Interconnect Parasitic, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters.

6.Combinational MOS Logic Circuits: Introduction, MOS Logic Circuits with Depletion NMOS

Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates).

UNIT:3 **10 Hours**

7.Sequential MOS Logic Circuits: Introduction, Behavior of Bistable Elements, SR Latch Circuits, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge-Triggered Flip-Flop.(Design with Verilog/VHDL/DSCH)

8.Dynamic Logic Circuits: Introduction, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High Performance Dynamic CMOS Circuits

UNIT:4 **10 Hours**

9.Design for Testability: Introduction, Fault Types and Models, Ad Hoc Testable Design Techniques, Scan-Based Techniques, Built-In Self-Test (BIST) Techniques,

Current Monitoring IDDQ Test.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books

1.CMOS Digital Integrated Circuits: Analysis and Design, Sung-Mo Kang and Yusuf Leblebici, Tata McGraw-Hill Publishing Company Limited, 3rdEdn, 2003.

2.Principles of CMOS VLSI Design – a Systems Perspective, K. Eshraghian and N.H.E. Weste, Addison Wesley,2nd Edition, 1993.

Ref. Books

1.Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, AnanthaChandrakasan, BorivojeNikolic, PHI, 2nd Edn.

2. Modern VLSI Design System– on – Chip Design, Wayne Wolf, PHI, 3rd Edn.

3. VLSI Design, Debaprasad Das, Oxford University Press, New Delhi, 2010.

4. CMOS Logic Circuit Design, John P. Uyemura, Springer, 2001.

5. Digital Integrated Circuit Design, Ken Martin, Oxford University Press, 2000.

6. VLSI Design Technique forAnalog and Digital Circuits, R LGEIGER, TMH.

7. Algorithms for VLSI Physical Design Automation, Naveed SHERWANI, BSP BOOKS PVT Ltd., 3rdEdition.

8.Introduction to VLSI Systems a logic, Circuits and System, Ming BOL in, BSP BOOKS PVT LTD

INFORMATION THEORY AND CODING

Subject Code	L	T	P	C	QP
BECPE 6041	**3**	**0**	**0**	**3**	

Pre -Requisite: A good understanding of probability theory is required.

Course Educational Objective

CEO1:The participants will learn the basic concepts of information theory and coding, including information, source coding, channel model, channel capacity, channel coding and so on.

CEO2:The main purpose of this course is to help students to complete the understanding of the wireless communication system with other advanced courses in wireless communication.

Course Outcomes

CO1 Understand and explain the basic concepts of information theory, source coding, channel and channel capacity, channel coding and relation among them.

CO2 Describe the real-life applications based on the fundamental theory.

CO3 Calculate entropy, channel capacity, bit error rate, code rate, steady-state probability and so on.

CO4 Implement the encoder and decoder of one block code or convolution code using any program language.

CO5 Distinguish between different types of error correcting codes based on probability of error and bit Energy to noise ratio.

CO6 Compare the performance of digital communication system by evaluating the probability of error for different error correcting codes

UNIT:1 **(10 Hrs)**

Basic Concepts of Information Theory- The concept of Amount of Information, Average Information, Entropy, Information rate, Mutual information; Shannon's Theorem, Channel capacity; BSC and other channels, Capacity of a Gaussian Channel, Bandwidth – S/N Tradeoff; Introduction to Channel Capacity & Coding; Channel Models, Channel Capacity Theorem, Shannon Limit.

UNIT:2 **(12Hrs)**

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 **(9Hrs)**

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 **(11Hrs)**

Discrete Messages and information content- The Concept of amount of Information, Average Information, Entropy; Information rate, Source coding to increase average information per bit; Shanon-Fano coding; Huffman source coding algorithm, Lempel Ziv source coding algorithm.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

TEXT BOOKS

1. Information Theory, Coding and Cryptography, Ranjan Bose, TMH Publication

2. Introduction to Error Control Codes, S Gravano, Oxford University Press

3. Digital Communications – Fundamentals and applications, Bernard Sklar, Pearson education Publication, 2ndEdition, 2009.

REFERENCE BOOKS

1. Information Coding Techniques, R. Avudaiammal, Tat McGraw-Hill Education Pvt. Ltd., 2ndEdition New Delhi

2. Information Theory, F.M Reza: McGraw Hill

3. Error Control Coding, Shu Lin& J Costeib:, PHI

NANO ELECTRONICS

Subject Code	L	T	P	C	QP
BECPC 4020	**3**	**0**	**0**	**3**	

Pre -Requisite: The students should have good background on microelectronics.

Course Educational Objective

CEO1: To provide the basic concepts about device architecture and interface engineering at nanoscale.

CEO2: To introduce different types of conventional and novel nanoelectronics devices for different applications.

CEO3: To provide the underlying physical processes governing the operation of spintronic devices and advance material(Graphene, CNT) based devices

CEO3: To familiar with modern MEMS/NEMS Devices

Course Outcome

At the end of the course students will be able to

CO1 Define the device physics in Nano scale engineering

CO2 Understand Nano device architectures in various applications

CO3 Apply the concept of spin during the electron transport across nanoelectronics devices.

CO4 Analyze the numerical simulations to understand fabrication process and device designing.

CO5 Evaluate the performance of Heterostructure devices using Nano science

CO6 Design the Graphene and CNT based Nano devices

UNIT:1 **(10 HOURS)**

Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger
equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids.
Kronig-Penny Model. Brillouin Zones

UNIT:2 **(10 HOURS)**

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.),

UNIT:3 **(10 HOURS)**

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Band structure and transport, devices, applications encoder, Optical encoder, Bimetallic strip, Strain gauge, load cell

UNIT:4 **(10 HOURS)**

2D semiconductors and electronic devices, Heterostructure devices, Graphene,CNT, atomistic simulation, Introduction to MEMS/NEMS

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

TEXT BOOKS

1. Stephen D. Sentaria, *Microsystem Design, Kluwer Academic Press*
2. Marc Madou, *Fundamentals of microfabrication& Nanofabrication.*
3. Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and ...
By Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, Cambridge University Press,2007
4. Julian W.Gardnes, Vijay K. Varda, *Micro sensors MEMS & Smart Devices, 2001.*
*5.*Semiconductor Devices, Physics and Technology, 8th edition, ISV (WSE) – 2015by Simon Sze Ming-Kwei Lee

REFERENCE BOOKS :

1. Nano Terchnology and Nano Electronics – Materials, devices and measurement Techniques by WR Fahrner – Springer
2. Nano: The Essentials – Understanding Nano Scinece and Nanotechnology by T.Pradeep;
Tata Mc.Graw Hill.
3. Spin Electronics by M. Ziese and M.J. Thornton
4. Nanoelectronics and Nanosystems – From Transistor to Molecular and Quantum Devices
by Karl Goser, Peter Glosekotter, Jan Dienstuhl
5. Silicon Nanoelectronics by ShunriOdo and David Feny, CRC Press, Taylor &Franicd Group
6. Nanotubes and nanowires by C.N.R. Rao and A. Govindaraj, RSC Publishing
7. Quantum-Based Electronic Devices and Systems by M. Dutta and M.A. Stroscio, World Scientific.
8. James R Sheats and Bruce w.Smith, “Microlithography Science and Technology”, Marcel Dekker Inc., New York, 1998.
9. J.P. Hirth and G.M.Pound “Evaporation: Nucleation and Growth Kinetics” Pergamon Press, Oxford,

Title of the subject

Subject Code		L	T	P	C	QP
BECPE 6043	**BIOMEDICAL ELECTRONICS**	**3**	**0**	**0**	**3**	

Pre -Requisite: Biomedical equipments, cells and tissues.

Course Educational Objective

CEO1: Successfully practice biomedical engineering to serve state and regional industries, hospitals, government agencies, or national and international industries.
CEO2: Continue to utilize and enhance their engineering and biological training to solve problems related to health and healthcare that are globally relevant and based on ethically sound principles.
CEO3: Demonstrate leadership in their respective careers in biomedical engineering or interrelated areas of industry, government, academia, and clinical practice.
CEO4: Engage in life-long learning by continuing their education in graduate or professional school or through opportunities for advanced career or professional training.

Course Outcome

At the end of the course, , students will be able to:

CO1 Define and recognize several signals which are drawn out from the human body.
CO2 Describe divergent physical inabilities in living body by biomedical electrodes.
CO3 Employ quality assurance, risk assessment, and ethical issues in the context of instrumentation for medicine and healthcare.
CO4 Examine & interpret the simulated and experimental data.
CO5 Set up the students to familiarize with various medical equipment's and their technical aspects.
CO6 Appraise independent thinking & learning for decision making in complex and unpredictable situations.

UNIT:1 **10 Hours**

BIOELECTRIC SIGNALS AND ELECTRODES:

Sources of biomedical signals, basic medical instrumentation system, PC based medical instruments, general constraints in design of medical instrumentation systems; origin of bioelectric signals, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG); Electrode tissue interface, polarization, skin contact impedance, motion artifacts, Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes; Electrocardiograph-block diagram, ECG leads, effects of artifacts, multi-channel

UNIT:2 **8 Hours**

PACEMAKERS & DEFIBRILLATOR:

Need for cardiac pacemaker, external pacemaker, implantable pacemakers-types, ventricular synchronous demand pacemaker, programmable pacemaker, power sources for implantable pacemakers; Need for Defibrillator, DC defibrillator, automatic external defibrillator, implantable defibrillators.

UNIT:3 **10 Hours**

BLOOD FLOW & CARDIAC OUTPUT MEASUREMENT:
Electromagnetic blood flow meter principle, square wave electromagnetic flow meter, Doppler shift ultrasonic flow meter.
ADVANCED DIAGNOSTIC & THERAPEUTIC INSTRUMENTS:
Principle of surgical diathermy & surgical diathermy machine, Electro diagnosis-Electrotherapy-functional block diagram and working, interferential current therapy.

UNIT:4 **10 Hours**

BIOSENSORS:

Electrochemical transducers, Electrode potential and reference electrodes, potentiometric sensors, aerometric sensors, electrochemical gas sensors; chemical Transducers of acoustic and thermal principles. Biosensors – Enzyme based biosensors, Immune sensors, and microbial sensors.

Teaching Methods: Chalk& Board/ PPT/Video Lectures.

Text Books:

1.Hand Book of Biomedical Instrumentation-2nd Edition by R.S.Khandpur, Tata McGraw Hill 2003

2. Biomedical Instrumentation and Measurements-2nd Edition by Leslie Cromwell, Fred J. Weibell,
Erich A. Pfeiffer, PHI learning Pvt Ltd 2nd Edition

Reference. Books:

1. Biomedical signal processing :Principles and Technique, D.C Reddy Tata McGraw- Hill Education Pvt.Ltd, 2005

2. Introduction to Biomedical Equipment Technology-4th Edition by Joseph J. Carr, John M. Brown, Pearson Education 2007

INTERNET OF THINGS

Subject Code	L	T	P	C	QP
	3	0	0	3	

Pre -Requisite: Micro-Controllers, I/O Devices, Wireless Sensor Network

Course Educational Objective

CEO1: Introduction and description of core concepts of IoT, role and scope of smart sensors for insuring convergence of Technologies and multidisciplinary engineering practices, Machine Intelligence Quotient.
CEO2: Understand IoT Market perspective and use of Devices in IoT Technology.
CEO3: Understand State of the Art – IoT Architecture.
CEO4: Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

Course Outcome

CO1 Understand the vision of IoT from a global context.

CO2 Building state of the art architecture in IoT.

CO3 Developing and modifying code for various sensor based applications using wireless sensor modules and other I/O modules used in WoT(Web of Things).

CO4 Use of Devices, Gateways and Data Management in IoT.

CO5 Identify the scopes of IoT and related new models for market strategic interaction by exploring the features of predictive data analytics in IoT.

CO6 Participants will be encouraged to orient themselves to specific focused areas of their interest with hands on training.

UNIT:1 **(10hrs)**

INTRODUCTION

Definitions and Functional Requirements –Motivation – Architecture - Web 3.0 View of IoT– Ubiquitous IoT Applications – Four Pillars of IoT – DNA of IoT - The Toolkit Approach for end-user. Participation in the Internet of Things. Middle-ware for IoT: Overview– communication middle-ware for IoT –IoT Information Security

UNIT:2 **(14hrs)**

IOT PROTOCOLS

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus – KNX – Zigbee Architecture – Network layer – APS layer – Security. Proximity Sensors-Magnetic Sensors-Gravity Sensors-Light Sensors.

UNIT:3 **(10hrs)**

WEB OF THINGS

Web of Things versus Internet of Things – Two Pillars of the Web – Architecture standardization for WoT– Platform Middle-ware for WoT – Unified Multi-tier WoT Architecture – WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing – Cloud Middle-ware – Cloud Standards – Cloud Providers and Systems – Mobile Cloud Computing – The Cloud of Things Architecture.

UNIT:4 **(10hrs)**

APPLICATIONS

Understanding NodeMCU and RaspberriPi. Internals and architecture of ESP8266 WiFi Module. Commercial Building Automation- Introduction, Case study: phase one- commercial building automation today, Case study: phase two- commercial building automation in the future.

Teaching Methods: Chalk & Board/ PPT/Video Lectures/Lecture by Industry Expert

Text Books :

Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press – 2012.

David Easley and Jon Kleinberg, “Networks, Crowds, and Markets: Reasoning About a Highly Connected World”, Cambridge University Press – 2010.

3. Dieter Uckelmann; Mark Harrison; Florian Michahelles, “ Architecting the Internet of Things” Springer – 2011.

Reference Books:

The Internet of Things: Applications to the Smart Grid and Building Automation by – Olivier Hersent, Omar Elloumi and David Boswarthick – Wiley Publications -2012.

ROBOTICS and ROBOT APPLICATIONS						
Subject Code		L	T	P	C	QP
		3	0	0	3	
Pre -Requisite: Mathematics and basic linear algebra						
Course Educational Objective						
CEO1: To introduce robotics in the fields of manufacturing, medicine, search and rescue, service, and entertainment.						
CEO2: To teach robotics as the synergistic integration of mechanics, electronics, controls, and computer science.						
CEO3: Research simple machines and the history of robotics.						
CEO4: Simple machines employbility with different types of motors for movement.						
Course Outcome						
CO1	To explain the basic principles of Robotic technology, configurations, control and programming of Robots.					
CO2	Design an industrial robot which can meet kinematic and dynamic constraints.					
CO3	To describe the concept of Robot kinematics and dynamics, latest algorithms & analytical approaches					
CO4	To introduce the most popular methods for motion planning and obstacle avoidance.					
CO5	To choose the appropriate Sensor and Machine vision system for a given application.					
CO6	To explain the basic principles of dynamics in programming and apply it for typical Pick & place,loading & unloading and palletizing applications.					

UNIT:1 **(10hrs)**

Introduction – Brief history, Definitions and Basic Structure of Robots with its Anatomy, Fundamentals about Robot Technology, Complete Classification of Robots, Elements of robots – links, joints, actuators and sensors. Some common sensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision. Factors related to use Robot Performance, Basic Robot Configurations and their Relative Merits and Demerits, the Wrist & Gripper Subassemblies. Concepts about Basic Control System, ,Control Loops of Robotic Systems, Different Types of Controllers-Proportional, Integral, Differential, PID controllers.

UNIT:2 **(10hrs)**

Kinematics of robots - Serial and Parallel Kinematics, Kinematics of Robot Manipulator - Introduction, General Mathematical Preliminaries onVectors & Matrices, Direct Kinematics problem, Geometry Based Direct kinematics problem, Co-ordinate and vector transformation using matrices, Rotation matrix, Inverse Transformations, Problems, Composite Rotation matrix, Homogenous Transformations, Robotic Manipulator Joint Co-Ordinate System, Euler Angle & Euler Transformations, Roll-Pitch-Yaw(RPY) Transformation. D H Representation & Displacement Matrices for Standard Configurations, Jacobian Transformation in Robotic Manipulation.

Velocity and static analysis of robot manipulators - Linear and angular velocity of links,Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough-Stewart platform, Singularity analysis and statics.

UNIT:3 **(10hrs)**

Dynamics of serial and parallel manipulators - Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators, Generation of symbolic equations of motion using a computer, Simulation (direct and inverse) of dynamic equations of motion, Examples of a planar 2R and four-bar mechanism,Recursive dynamics, Commercially available multi-body simulation software (ADAMS) and Computer algebra software Maple.

UNIT:4 **(10hrs)**

Motion planning and control - Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators.

Industrial Applications – Objectives, Robot Application in Industry, Task Programming, Robot Intelligence and Task Planning, Modern Robots, Robotic Assembly Sensors and Intelligent Sensors. Future Application and Challenges and Case Studies.

Teaching Methods: Chalk & Board/ PPT/Video Lectures/Lecture by Industry Expert

Text Books :

1. Robotics, control vision and intelligence-Fu, Lee and Gonzalez. McGraw Hill International, 2nd edition, 2007.
2. Introduction to Robotics- John J. Craig, Addison Wesley Publishing, 3 rd edition, 2010.

Reference Books:

1. Robotics for Engineers -YoramKoren, McGraw Hill International, 1 st edition, 1985.
2. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2 nd edition, 2012.
3. Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1 st edition, 2009.
4. Murray, R.M., Li, Z ., and Sastry, S. S., A Mathematical Introduction to Robotic Manipulator, CRC Press, 1994.
5. Merlet, J.-P., Parallel Robots, Kluwer Academic, Dordrecht, 2001.

Subject Code	**Digital Communication Laboratory**	L	T	P	C	QP
BECPC 6110		0	0	2	1	

Pre-Requisites (If any) – Basic Knowledge of analog communication & electronic circuits.

Course Educational Objective

CEO -1 : To understand and analyze the signal flow in a digital communication system

CEO-2 : To gain the practical hands-on experience of digital Modulations & communications Schemes.

Course Outcomes

CO1 Able to understand basic theories of Digital communication system in practical.

CO2 Able to design and implement different digital modulation and demodulation techniques.

CO3 Application of skills to use modern engineering tools, softwares& equipment's to analyze problems.

CO4 Able to identify and describe different techniques in modern digital communications, in particular in source coding using MAT Lab tools.

CO5 Able to understand the different types of signals, channel coding techniques.

CO6 Learn the generation and detection of base band system.

List of Experiments:

1. Study the functioning of PCM and Delta modulator; Demonstrate the process of PCM modulation and Delta modulation.
2. Modulation generation and detection Signal generator CRO
3. To study Time division multiplexing.
4. To study the different channel coding and decoding technique.
5. Generation and reception of different types of signals like ASK, PSK, FSK.
6. To transmit and receive three separate signal audio, video, tone simultaneously through satellite link.
7. To transmit PC data through satellite link using a satellite communication Demonstration unit.
8. Experimentally compare different forms of BPSK, QPSK, and OQPSK and analyze their Spectrum with spectrum analyzer.
9. Spreading and dispreading using additive white Gaussian noise generation/ Gold code and other forms of spreading techniques.
10. Transmit different types of signals using ISDN system.
11. Analyze the process of data communication in LAN using LAN trainer and Compare the performance different media access techniques.

DIGITAL SIGNAL PROCESSING LABORATORY

Subject Code	L	T	P	C	QP
BECPC 6120	0	0	2	1	

Pre -Requisite:

Course Educational Objective

CEO1: Familiar about the concept of MATLAB in various digital signal processing.
CEO2: Design and develop new algorithm and basic model for digital signal processing.
CEO3: Apply Novel method approach with MATLAB for analyzing various noisy signals.
CEO4: Use the basic approach of digital signal processing in advanced concept of signal; processing like image processing, speech processing e.t.c.

CO1 Represent the discrete signal in frequencydomain using MATLAB.
CO2 Understand the importance of random signal processing in DSP, and its application on statistical measures, prediction...
CO3 Verify the various signals processing technique, data modeling using MATLAB.
CO4 Analyze the concept of fast computation of signal processing in MATLAB.
CO5 Design digital filters on paper by using MATLAB, and implement the design using kit and with some simulation techniques
CO6 Implement the concept of dsp in practical realization of filter for various signal processing, image processing and advanced signal processing.

Write a MATLAB programme for generation of different discrete signal.
Write a MATLAB program to perform circular convolution two discrete time sequences. Plot all the sequences. Verify the result by analytical calculation.
Write a MATLAB program to find the circular autocorrelation and circular cross correlation of sequences.
Write a MATLAB program to find Convolution of long duration sequences using overlap add Method.
Write a MATLAB program to find Convolution of long duration sequences using overlap save Method.
Write a MATLAB program to find the N Point DFT AND IDFT of a sequence
Write a MATLAB program to calculate the circular convolution two discrete time sequences using DFT and IDFT.
Write a MATLAB program to find the DIT -FFT of a sequence.
Write a MATLAB program to find the DIF- FFT of a sequence
Generation of various types of waveforms (sine, cosine, square, triangular etc.) using TMS 320C6XXX DSP kit.
.Design and implementation of FIR (lowpass and highpass) Filters using windowing techniques (rectangular window, triangular window and Kaiser Window) in MATLAB and DSP kit.
Design and implementation of IIR (lowpass and highpass) Filters (Butterworth and

Chebyshev) in MATLAB and DSP kit.
Computation of the power spectral density of a sequence using MATLAB also
Implementing the same in a DSP kit.
14.Write a MATLAB program to illustrate adaptive filtering using the LMS algorithms

Teaching Methods: LCD/SYSTEM / PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books

Digital Signal Processing: WITH DSP Laboratory Using MATLAB: A Computer-Based Approach (McGraw-Hill Series in Electrical and Computer Engineering) 2nd Edition by Sanjit K. Mitra

Digital Signal Processing Using MATLAB Authors: John G. Proakis

Ref. Books

Digital Signal Processing Laboratory, Second Edition 2nd Edition by B. reetham Kumar

Digital Signal Processing Laboratory Experiments using MATLAB by HardikModi

http://www.ece.iit.edu/~biitcomm/Yarmouk/Digital

Subject Code	**DIGITAL VLSI DESIGN LABORATORY**	L	T	P	C	QP
BECPC 6110	Course Educational Objective	0	0	2	1	

Pre-Requisites – Fundamental of Analogue Electronic Circuit, Digital Electronics Circuit, Physical Semiconductor Devices

Course Outcome

At the end of the course students will be able to

CO1	Understand the static and dynamic behavior of MOSFETs (Metal Oxide Semiconductor Field Effect Transistors) and the secondary effects of the MOS transistor model.
CO2	Taware about the trends in semiconductor technology, and how it impacts scaling and its effect on device density, speed and power consumption.
CO3	Illustrate the behavior of MOS transistor as a switch and its capacitance.
CO4	Analyze the area ,delay and speed of the digital and analog circuits
CO5	Evaluate different VLSI Circuits on the basis of area ,delay and speed
CO6	Design and implementation of digital blocks in FPGA

List of Experiments :

1. Design of schematic and simple layout for CMOS Inverter & perform parasitic extraction and simulation.

2. Design of schematic and simple layout for CMOS NAND gate & perform parasitic extraction and simulation.

3. Design of schematic and simple layout for CMOS NOR gate & perform parasitic extraction and simulation.

4. Plotting of VTC curve of CMOS inverter using p-SPICE.

5. Modelling and transient analysis of 2-inputs NAND & NOR gates using p-SPICE.

6. Design a 4-bit adder -cum-sub tractor using:

7.4:1 MUX using the following:

(a) Dataflow

(b) Using when else

(c) Structural modeling using 2:1 MUX

(d) Behavioral modeling using

Subject Code	**DIGITAL VLSI DESIGN LABORATORY**	L	T	P	C	QP
BEOPC 6110	Course Educational Objective	0	0	2	1	

(i) Case statement

(ii) Design 3:8 decoder (3: 8) and 8:3 encoder (only logical operation).

9. Design a BCD to 7-Segment Decoder.

10. Interface the 2-bit adder with 7-segment display.

11. Design 4-bit Even/Odd parity checker & generator.

12. Design of Flip-Flops:

(a) S-R Flip Flop (b) J-K Flip Flop (c) D Flip Flop (d) T Flip Flop

13. Design of counters: 4-bit up/down counters

14. Design & implementation of 16-bit Arithmetic & Logic unit using VHDL/Verilog

15. Design of a simple Microprocessor Data Path and Control Path using VHDL modeling

Advanced Lab I

Subject Code	L	T	P	C	QP
	3	0	0	3	

Pre -Requisite: Micro-Controllers, I/O Devices

Course Educational Objective

CEO1: Introduction and description of core concepts of Embedded Systems with a core Micro-Controller, role and scope of smart sensors for insuring convergence of Technologies and multidisciplinary engineering practices.

CEO2: Understand Embedded Market perspective and use of Devices in this Technology.

CEO3: Understand State of the Art – Embedded Architecture.

CEO4: Real World Embedded Design Constraints, Industrial Automation and Commercial Building Automation.

Course Outcome

CO1 Understanding basics of all kinds of Embedded Systems
CO2 Basics Implementation of Embedded Hardware Parts
CO3 Delivering a practical approach towards automation
CO4 Implementing hardware's and software's together.
CO5 Building a sense of Innovation
CO6 Able to integrate different hardware parts.

Program for LED Blinking
Program for LED Patterns.
Program for RGB glow(RED, GREEN, BLUE).
Program for Seven Segment Dispaly as counter.
Program for ON/OFF switch to start a timer.
Program for DTMF controlled embedded system.
Prgram for controlling the Infrared Sensors.
Program for implementing password by matrix keypad.
Program for LCD based content display.
Program for sound controlled embedded system.
Program for dc-motor controlled embedded system
Program for controlling embedded gadjects through SMART Phone
Teaching Methods: Chalk & Board/ PPT/Video Lectures/Lecture by Industry Expert

Text Books :

1. AVR Microcontroller and Embedded Systems: Pearson New International Edition: ...

Book by Muhammad Ali Mazidi, Sarmad Naimi, and Sepehr Naimi

Reference Books:

1. Embedded System Design with the Atmel AVR Microcontroller Textbook by Steven F. Barrett

2. C Programming for Microcontrollers: Featuring ATMEL's AVR Butterfly and free WinAVR Compiler Book by Joe Pardue

3. The 8051 Microcontroller and Embedded Systems: Using Assembly and C

Book by Janice Gillispie Mazidi, Muhammad Ali Mazidi, and Rolin D. McKinlay

CO - PO Matrix of Course