Department of

ELECTRONICS AND COMMUNICATION ENGINEERING

4 Years B.Tech Degree Programme

REGULATION & SYLLABUS 2017

Choice Based Credit System
Outcome Based Assessment

SEMESTER-VII & VIII

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.

VII SEMESTER [FOURTH YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1	PC	BECPC7010	High Frequency Engineering	3	0	0	3	A
2	PE	BECPE7021	Mobile Communication	3	0	0	3	A
		BECPE7022	Antennas and Wave Propagation					
		BECPE7023	Analog VLSI Design					
		BCSPE7024	Pattern Analysis and Machine Intelligence					
3	PE	BECPE7031	Embedded Systems	3	0	0	3	A
		BECPE7032	Adaptive Signal Processing					
		BECPE7033	Advanced Control Systems					
		BECPE7034	Industrial Electronics					
4	PE	BECPE7041	Speech and Audio Processing	3	0	0	3	A
		BECPE7042	Mixed Signal Design					
		BECPE7043	Telecommunication System Modeling and Simulation					
		BCSPE7044	Fuzzy Logic and Neural Networks					
5	OE	BECOE7051	Engineering Acoustics	3	0	0	3	A
		BCSOE7052	Soft Computing					
		BCSOE7053	Big Data Analysis					
PRACTICAL / SESSIONAL								
6	PC	BECPC7110	High Frequency Engineering Laboratory	0	0	2	1	-
7	PC	BECPC7140	Advanced Laboratory-II	0	0	2	1	-
8	PC	BECPC7150	Mini Project / Projects on Internet of Things	0	0	6	3	-
9	PE	BECPE7160	## Massive Open Online Course (MOOC)	0	0	4	2	-
10	PC	BECPC7170	^Summer Internship-II	0	0	2	1	-
TOTAL				**15**	**0**	**16**	**23**	

##Meeting with the global requirements, to inculcate the habit of self-learning and in compliance with UGC guidelines, Massive Open Online Course (MOOC) have been introduced as electives and it can be selected with the latest industrial requirement.

VIII SEMESTER [FOURTH YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	C	QP
THEORY								
1	PE	BECPE8011	Satellite Communication	3	0	0	3	A
		BEIPE8012	Micro-Electro-Mechanical Systems					
		BECPE8013	High Speed Electronics					
		BECPE8014	Wavelet Transforms					
2	PE	BECPE8021	Digital Image and Video Processing	3	0	0	3	A
		BECPE8022	Optical Communication and Networking					
		BCSPE8023	Wireless Sensor Networks					
		BCSPE8024	Cryptography and Network Security					
3	OE	BECOE8031	Remote Sensing	3	0	0	3	A
		BCSOE8032	Cloud Computing					
		BMSOE8033	Operation Research					
PRACTICAL / SESSIONAL								
4	PC	BECPC8150	Major Project / Industrial Project / Startup Training cum Project	0	0	12	6	-
5	PC	BECPC8180	Seminar and Technical Writing	0	0	4	2	-
6	PC	BECPC8190	Comprehensive Viva-Voce	0	0	4	2	-
TOTAL				**9**	**0**	**20**	**19**	

HIGH FREQUENCY ENGINEERING

Subject Code	L	T	P	C	QP
BECPC 4040	3	1	0	4	

Pre -Requisite: The students should have good background knowledge on semiconductor devices and its properties.

Course Educational Objective

CEO1: To gain basic knowledge on solid state devices and their application to high frequency.

CEO2: Provide students the insight for understanding new semiconductor devices and technologies.

CEO3: To provide the students a solid platform on solid state devices which can help them to work upon on real field applications like High frequency communications, radar communication etc.

COURSE OUTCOME

CO1 Recognize the limitations of existing vacuumtubes and solid state devices at microwave frequencies

CO2 Study the performance ofspecialized microwave tubes such as klystron, reflex klystron, magnetron and Travelling wave tube.

CO3 Understand the operation of passive waveguide components.

CO4 Analyze microwave circuitsusing scattering parameters

CO5 Test microwave components and circuits with standard microwave bench and vector network analyzer

CO6 To describe the principle of Radar and types of Radars.

UNIT: 1 **12 HOURS**

Introduction High Frequency Engineering. Microwave Tubes-

Limitations of conventional tubes.IEC, LI, Transit Time Effect Gain-Bandwidth, RF Limitations .Two Cavity Klystron Tube-Construction. Two Cavity Klystron Tube-Operation and Application.Reflex Klystron-Construction. Reflex Klystron- Operation and Application. Travelling Wave Tube(TWT)-Construction. Travelling Wave Tube(TWT)- Operation and Application. Magnetron-Construction. Magnetron- Operation and Application. Backward Wave Oscillators-Construction , Operation and Application. Crossed field amplifiers-Construction and Operation.

UNIT:2 **12 HOURS**

Microwave Solid State Devices.

Limitation of conventional solid state devices at Microwaves. Microwave Bipolar Junction Transistors Structure. Microwave Bipolar Junction Transistors Operation. Microwave Field Effect Transistors Structure. Microwave Field Effect Transistors Operation. PIN Diode-Construction & Operation. Schottky Barrier Diode(SBD)- Construction & Operation.

Transferred Electron Devices (Gunn diode). Avalanche transit time effect –IMPATT Diodes. TRAPATT Diodes. Microwave Amplification by Stimulated Emission of Radiation (MASER)

UNIT:3 **10 HOURS**

Microwave Components-

Analysis of Microwave components -s-parameters. Junctions (E, H, Hybrid). Directional coupler. Bends and Corners. Microwave posts. S.S. tuners, Attenuators, Phase shifter. Ferrite devices (Isolator). Ferrite devices (Circulator, Gyrator). Cavity resonator

UNIT:4 **8 HOURS**

Introduction to Radar Systems-

Basic Principle-Block diagram. Operation of Radar. Radar range Equation. Pulse Repetition Frequency (PRF) and Range Ambiguities. Doppler Radars- Doppler determination of velocity. Continuous Wave (CW) radar and its limitations. Frequency Modulated Continuous Wave (FMCW) radar. Basic principle and operation of Moving Target Indicator (MTI) radar. Delay line cancellers. Blind speeds and staggered PRFs

Scanning and Tracking Techniques-

Various scanning techniques (Horizontal, vertical, Spiral); Scanning and Tracking Techniques- Various scanning techniques (palmer, raster, nodding); Angle tracking systems (Lobe switching, conical scan). Angle tracking systems (mono pulse),

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

Text Books

1. Microwave Engineering, David M. Pozer, Fourth Edition, Wiley Publications, 2011
2. Introduction to radar systems, Merill I. Skolink, McGraw Hill Publications, Second Edition, 2001
3. Microwave and Radar Engineering, G. S. Rao, Pearson India Publisher, 2014

Ref. Books

Microwave devices and Circuits, Samuel Liao, Pearson Education Publisher, Third Edition,1990
Foundation of Microwave Engg, R.E. Collin, Second Edition,Wiley Publications, 2007
Microwave devices and Radar Engg, M. Kulkarni; Umesh Publications, Fifth Edition,1998
4. Microwave Engineering, Subol Kar, University Press.

Mobile Communication

Subject Code	L	T	P	C	QP
BECPE 7021	**3**	**0**	**0**	**3**	

Pre -Requisite: Digital communication .Basic knowledge in modulation techniques, communication systems and elementary calculus

Course Educational Objective

CEO1: Discuss the concept of digital cellular systems (cdma2000, WLAN, LTE).

CEO2: synthesis and analyze wireless and mobile cellular communication systems over a stochastic fading channel

Course Outcome

CO1 Relate the evolution of 4G from 1G.
CO2 Describe various wireless systems and standards and their basic operation cases
CO3 Illustrate the basic concept of cellular system design.
CO4 Calculate the system performance for different antenna at worst case condition.
CO5 Analyze and design wireless and mobile cellular systems.
CO6 Estimate the ability to work in advanced research wireless and mobile cellular programs like diversity techniques & equalization.

UNIT:1 **(14 HOURS)**

An Overview of Wireless Systems- Introduction, First and Second Generation Cellular Systems, Cellular Communications from 1G to 3G, Wireless 4G Systems; Future Wireless Networks

Fundamentals of Cellular Communications- Introduction, Cellular Systems, Hexagonal Cell Geometry, Co-channel Interference Ratio, Cellular System Design in Worst-Case Scenario with an Omni directional Antenna, Co-channel Interference Reduction, Directional Antennas in Seven-Cell Reuse Pattern, Cell Splitting, Adjacent Channel Interference (ACI),handoff strategy.

UNIT:2 **(10 HOURS)**

Radio Propagation and path loss Models: Introduction, Free-space Attenuation, Attenuation over Reflecting Surfaces, Two-ray propagation Model, Characteristics of Wireless Channel: Coherence Time ,Coherence bandwidth, Doppler shift, Signal Fading Statistics, Propagation Path-loss Models -Cost 231 Model.

UNIT:3 **(8 HOURS)**

Wireless Application and Standards- Fundamentals of WLAN transmission technology, WLAN system architecture and its applications, IEEE 802.11, 802.11 systems architecture; WiMAX standards, Zigbee.

UNIT:4 **(8 HOURS)**

Multiple Access Techniques- Introduction, Narrowband Channelized Systems, FDMA, TDMA and CDMA, System Capacity.
Spread Spectrum : Introduction, Types of spread spectrum : DSSS&FHSS.Their operation, Processing gain, Diversity techniques

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

TEXT BOOKS

1. Wireless Communication and Networking, Essential Reading, V K Garg , Morgan Kaufman Publishers India; 2008
2. Wireless communication & networks, UpenDalal, Oxford University Press, 2014

REFERENCE BOOKS

1. Wireless Communications, T S Rappaport, Pearson Education, India
2. Mobile Communication Engineering – Theory and Applications, W C Y Lee, TMH
3. Wireless Communications, T L Singhal, Tata McGraw Hill, 2010 4. Wireless communication, A Goldsmith, Cambridge

ANTENNAS & WAVE PROPAGATION

Subject Code	L	T	P	C	QP
BECPE7022	**3**	**1**	**0**	**4**	**A**

Pre -Requisite: Electromagnetic Engineering

Course Educational Objective

CEO1: To give the idea about electromagnetics and vector calculus

CEO2: Provide the details of the parameters of an antenna.

CEO3: To ascertain the implementation of antennas in day to day life

CEO4: To provide the idea about the ionospheric radiation

Course Outcome

CO1 Define various antenna parameters

CO2 Analyse radiation patterns of antennas

CO3 Evaluate antennas for given specifications

CO4 Provide techniques for antenna parameter measurements

CO5 Ascertain the implementation of antennas with the fabrication and testing

CO6 Provide the idea radio wave propagation

MODULE:1 **(10 Hours)**

Electromagnetic radiation and antenna fundamentals- Review of electromagnetic theory: Vector Potential , Solution of wave equation, retarded case, Hertizian dipole. Antenna characteristics: Radiation pattern, Beam solid angle, Directivity, Gain, Input Impedance, Polarization, Bandwidth, Reciprocity, Equivalence of Radiation patterns, Equivalence of Impedances, Effective aperture , Vector effective length, Antenna temperature.

MODULE:2 **(8 Hours)**

Wire antennas:- Short dipole, Radiation resistance and Directivity, Half wave Dipole, Monopole, Small loop antennas. Antenna Arrays: Linear Array and Pattern Multiplication, Two-element Array, Uniform Array, Polynomial representation, Array with non-uniform Excitation-Binomial Array.

MODULE:3 **(8 Hours)**

Aperture Antennas:- Magnetic Current and its fields, Uniqueness theorem, Field equivalence principle, Duality principle, Method of Images, Pattern properties, Slot antenna, Horn Antenna, Pyramidal Horn Antenna, Reflector Antenna-Flat reflector, Corner Reflector, Common curved reflector shapes, Lens Antenna.

MODULE:4 **(12Hours)**

Special Antennas:-Long wire, V and Rhombic Antenna, Yagi-UdaAntena, Turnstile periodic Dipole Array, Spiral Antenna, Microstrip Patch Antennas.

Antenna Measurements:-Radiation Pattern measurement, Gain and Directivity Measurements , Anechoic Chamber measurement.

Radio wave propagation- Calculation of Great Circle Distance between any two points on earth, Ground Wave Propagation, Free-space Propagation, Ground Reflection, Surface waves, Diffraction, Wave propagation in complex Environments, Tropospheric Propagation, Tropospheric Scatter. Ionospheric propagation: Structure of ionosphere, Sky waves, skip distance, Virtual height, Critical frequency, MUF, Electrical properties of ionosphere, Effects of earth's magnetic fields, Faraday rotation, Whistlers.

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

Text Books

Antenna Theory Analysis and Design, C. A. Ballanis, John Wiley Publications, Second Edition, 2005.

Antennas and Wave Propagation, A. R. Harish, M. Sachidanada, Oxford University Press,2007

References Books

Antennas for all Applications, J.D .Kraus, Ronald J Marhefka and Ahmad S Khan, Tata McGraw-Hill Book Company. Third Edition , 2008.

Antenna Wave Propagation, G.S.N. Raju, Pearson Education, 2006.

Antenna and Radio Wave Propagation, R. E. Collin, McGraw Hill Publications, 1985.

Antenna Analysis and Design, W.L Stutzman and G.A. Thiele, John Wiley Publications,2012.

Analog VLSI Design

Subject Code	L	T	P	C	QP
BECPE7023	**3**	**0**	**0**	**3**	

Pre -Requisite: Analog Electronics Circuits, Advanced Electronics Circuits

Course Educational Objective

CEO1: To familiar withAnalog circuits using CMOS
CEO2: To design the single stage and differential MOS amplifiers& current mirrors
CEO3: To analyze the frequency response of OP-AMP circuits & MOS amplifiers
CEO4: To design reference circuits to test the analog ICs

Course Outcome

At the end of the course students will be able to

CO1 Define the significance of different biasing styles & their implementation in CMOS Analog Circuits
CO2 Understand basic building blocks like sources, sinks, mirrors, up to layout level
CO3 Comprehend the stability issues of the systems and design OpAmp fully compensated against process, supply and temperature variations
CO4 Analyze suitable topologies of the constituent sub systems and corresponding circuits as per the specifications of the system
CO5 Design Analog integrated system including parasitic effects upto tape-out
CO6 Become proficient with computer skills (eg.,Multisim, HSPICE, Virtuoso) for the analysis and design of circuits.

UNIT:1 **12 Hours**

MOS FET device I/V characteristics, second order effects, Capacitances, body bias effect, Biasing Styles, MOS small signal Model, NMOS verses PMOS devices.

Basic building blocks and basic cells-Switches, active resistors, Current sources and sinks, Current mirrors: Basic current mirror, cascode current mirror, low voltage current mirror, Wilson and Widlar current mirrors,

UNIT:2. **08 Hours**

Voltage and current references, Single stage amplifier: Common source stage with resistive load, diode connected load, triode load, CS stage with source degeneration, source follower, CG stage, Gain boosting techniques, Cascode, folded cascode, choice of device models

UNIT:3 10 Hours

CMOS analog blocks: Differential amplifier and OPAMP design (Quasi differential amplifier, significance of tail current source, errors due to mismatch, replication principle, qualitative analysis, common mode response, differential amplifier with MOS loads, single ended conversion, gilbert cell. Operational amplifier characterization, 2 stage OP amp, process and temperature independent compensation, output stage); Frequency Synthesizers and Phased lock-loops

UNIT:4. **10 Hours**

Band Gap Reference: General considerations, Supply independent biasing, temperature independent references, negative-TC voltage, positive TC voltage, Bandgap reference, PTAT generation, constant gm biasing, speed and noise issues, case study, curvature correction. PTAT, CTAT, Bandgap circuit, start-up circuit, curvature correction Design

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

Text Books

1. P R Gray and R G Meyer, Analysis and Design of Analog Integrated Circuits, 5th Edition, Wiley, 2009.

2. Mohammed Ismail and Terri Fiez, Analog VLSI: Signal and Information Processing, McGraw-Hill, 1994.

3. Geiger, Allen and Stradder, VLSI Design Techniques for Analog and Digital Circuits, Tata McGraw-Hill Education, 2010.

4.Design of Analog CMOS Integrated Circuits, BehzadRazavi, Tata McGraw-Hill Publishing Company Limited, 2002.

Ref. Books

1) David A Johns, Ken Martin: Analog IC design, Wiley 2008.

2) R Gregorian and G C Temes: Analog MOS integrated circuits for signal processing, Wiley 1986

3)CMOS Analog Circuit Design, D. Holberg and P. Allen, Oxford University Press, 2002

Embedded Systems

Subject Code	L	T	P	C	QP
BECPE 7031	**3**	**0**	**0**	**3**	

Pre -Requisite: Fundamentals Of C language and Microcontrollers.

Course Educational Objective

CEO1: Discuss the major components that constitute an embedded system

CEO2: Implement small programs to solve well defined problems on embedded platform

CEO3: Develop familiarity with tools used to develop in an embedded system

CEO4: Design embedded system for the betterment of the society

Course Outcome

CO1 Define the fundamentals of Embedded system

CO2 Explain the difference between microprocessor & microcontroller

CO3 Demonstrate the advantage of Real time operating system

CO4 Understand the basic architecture of microcontrollers

CO5 Design Embedded systems using Embedded C

CO6 Assess the efficiency and functionality of Embedded systems

Module I Hardware Concepts **10 hours**

Application and characteristics of embedded systems, Overview of Processors and hardware units in an embedded system, General purpose processors, Microcontrollers, ARM-based Systems on a Chip (SoC), Application-Specific Circuits (ASICs), Levels of hardware modelling, VHDL, Sensors, A/D-D/A converters, Actuators, Interfacing using UART, USB, CAN bus, SRAM and DRAM, Flash memory

Module II

Embedded C and AVR **15 hours**

Introduction to Embedded systems design:

Introduction to Embedded system, Embedded System Project Management, ESD and Co-design issues in System development Process, Design cycle in the development phase for an embedded system, Use of target system or its emulator and In-circuit emulator, Use of software tools for development of an ES.

Embedded C Programming:

Embedded C V/s C language, DDR, PORT and PIN commands, special data types, Infinite while loop, if conditions

AVR Interfacing and Applications:

Interfacing External Memory, Keyboard and Display Devices: LED, 7-segment LED display, LCD, Ultrasonic Sensor, IR Sensor.

Proteus Design Suite: Circuit building for all applications

Module III

Real Time Operating System **12 hours**

Real-Time Task Scheduling: Some important concepts, Types of real-time tasks and their characteristics, Task scheduling, Clock-Driven scheduling, Hybrid schedulers, Event-Driven scheduling, Earliest Deadline First (EDF) scheduling, Rate monotonic algorithm (RMA). Commercial Real-time operating systems: Time services, Features of a Real-time operating system, Unix-based Real-time operating systems, POSIX-RT, A survey of contemporary Real-time operating systems, Microkernel-based systems.

Module IV

Embedded Application Development **8 hours**

Embedded system development life cycle, State charts, General language characteristics , Features of MISRA C for embedded programming, Hardware/Software Co-design ,

Hardware/software partitioning, Testing embedded systems, Design for testability and Self-test.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/ Model demonstration

Text Books

1. Frank Vahid and Tony Givargis, Embedded Systems Design – A unified Hardware /Software Introduction, John Wiley, 2002. (For Module 1)
2. David E.Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.(For module 3 & 4)

Ref. Books

1. S. Chattopadhyay, Embedded System Design, PHI
2. Shibu KV, Introduction to Embedded Systems, TMH
3. Wayne Wolf, Computers as Components; Principles of Embedded Computing System Design – Harcourt India, Morgan Kaufman Publishers, 2001
4. Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGraw-Hill, 2003

Subject Code	**ADAPTIVE SIGNAL PROCESSING**	L	T	P	C	QP
BECPE7032		3	0	0	3	

Pre -Requisite:Signals & Systems, Digital Signal Processing

Course Educational Objective

CEO1: Perform simple spectral factorization tasks.
CEO2: Derive and apply the principle of statistical orthogonality
CEO3: Design infinite impulse response (IIR) filters
CEO4: Derive the least mean squares (LMS) and recursive least squares (RLS) adaptive filter algorithms and apply them to problems in system identification, linear predication and equalization

Course Outcome

At the end of the course students will be able to

CO1 Use basic probability theory to model random signals in terms of Random Processes.
CO2 Use covariance matrices to describe the second order statistics of Random Processes.
CO3 Understand and derive the Wiener filter for signals with known second order statistics and formulate the Wiener filter as a constrained optimization problem.
CO4 Use and understand the LMS algorithm for iteratively estimating the Wiener filter weights.
CO5 Determine suitable LMS step size to trade off convergence time and misadjustment
CO6 Evaluate quantitative models for various engineering applications.

UNIT:1 **(10hrs)**

Introduction: Adaptive Systems - Definition and characteristics, General properties, Open and Closed Loop Adaptations, Applications
The Adaptive Linear Combiner: Performance function, Gradient and Mean Square Error, Examples.

UNIT:2 **(12hrs)**

Theory of Adaptation with Stationary Signals: Properties of the Quadratic Performance Surface, Significance of eigen values, eigen vectors, coorelation matrix.
Searching the Proformance Surface: A simple gradient search algorithm, Stability and Rate of convergence, the learning curve
Gradient Estimation and its effects on Adoption: The performance penalty, Variance of the gradient estimate, Misadjustment

UNIT:3 **(10hrs)**

Adaptive Algorithms and Structures: The LMS Algorithm, Convergence, learning Curve, Performance analysis, Filtered X LMS algorithm,
Vector space of random variables, correlation as inner product, forward and backward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

UNIT:4 **(10hrs)**

Applications: Adaptive Modeling and System Identification using adaptive filter, Inverse Adaptive Modeling, Deconvolution, and equalization using adaptive filter, Adaptive Control Systems using Filtered X LMS Algorithm, Adaptive Noise Cancellation using Adaptive filter

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

Text Books :

Bernard Widrow and Samuel D. Stearns, Adaptive Signal Processing, Pearson Education, 2nd impression 2009.

Reference Books:

Simon Haykin, Adaptive Filter Theory, 4th Edn., Pearson Education.
C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

Title of the subject

Subject Code		L	T	P	C	QP
PET7J005	**ADVANCE CONTROL SYSTEM**	**3**	**1**	**0**	**4**	

Pre -Requisite: Control System

Course Educational Objective

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

CEO1: Toassure knowledge of state space & state feedback, pole placement & integral control in modern control systems.

CEO2: To design state observers and output feedback controllers.

CEO3: To develop analysis and design skills in adaptive control, optimal control and robust control of multivariable systems.

Course Outcome

CO1 Understand digital control systems and its applications.

CO2 Recognize the nonlinearities in different physical systems.

CO3 Demonstrate various physical nonlinearities in day today life.

CO4 Analyze state models for linear continuous – time systems.

CO5 Design the non linear systems in phase plane as well as different control systems in state space.

CO6 Justify the stability of close loop systems in the Z-plane.

UNIT:1 **(15 Hrs)**

INTRODUCTION: Discrete Time Control Systems and Continuous Time Control Systems,Sampling Process.

DIGITAL CONTROL SYSTEMS: Sample and Hold, Analog to digital conversion, Digital to analogconversion.

THE Z-TRANSFORM: Discrete-Time Signals, The Z-transform, Z-transform of Elementaryfunctions, Important properties and Theorems of the Z-transform. The inverse Z-transform, Z-Transform method for solving Difference Equations.

Z-PLANE ANALYSIS OF DISCRETE TIME CONTROL SYSTEMS: Impulse sampling & Data Hold.

RECONSTRUCTION OF ORIGINAL SIGNALS FROM SAMPLED SIGNALS: Sampling theorem, folding,aliasing, Starred Laplace Transform of the signal involving both ordinary and starred Laplace Transforms, General procedures for obtaining pulse Transfer functions, Pulse Transfer function of open loop and closed loop systems. Mapping between the s-plane and the z-plan

STABILITY ANALYSIS OF CLOSED LOOP SYSTEMS IN THE Z-PLANE: Stability analysis by use of the Bilinear Transformation and Routh stability criterion.

UNIT:2 **(14 Hours)**

INTRODUCTION: CONCEPTS OF STATE, STATE VARIABLES AND STATE

MODEL: State Model of Linear Systems, State Model for Single-Input-Single-Output LinearSystems, Linearization of the State Equation.

STATE MODELS FOR LINEAR CONTINUOUS – TIMESYSTEMS: State-Space Representation Using Physical Variables, State – spaceRepresentation Using Phase Variables, Phase variable formulations for transfer function with poles and zeros, State-space Representation using Canonical Variables, Derivation of Transfer Function for State Model.

SOLUTION OF STATE EQUATIONS: Properties of the State Transition Matrix, Computation of State Transition Matrix, Computation by Techniques Based on the Cayley-Hamilton Theorem, Sylvester's Expansion theorm.

CONCEPTS OF CONTROLLABILITY ANDOBSERVABILITY: Controllability, Observability, Effect of Pole-zero Cancellation in Transfer Function. Pole Placement by State Feedback, Observer Systems. State Variables and Linear Discrete – Time Systems: State Models from Linear Difference Equations/z-transfer Functions, Solution of State Equations (Discrete Case), An Efficient Method of Discretization and Solution, Linear Transformation of State Vector (Discrete-Time Case), Derivation of z-Transfer Function from Discrete-Time State Model.

UNIT: 3 **(3 Hours)**

INTRODUCTION TO NON LINEAR SYSTEM:Behavior of Nonlinear Systems, Investigation of nonlinear systems.

COMMON PHYSICAL NON LINEARITIES: Saturation, Friction, Backlash, Relay, MultivariableNonlinearity.

UNIT:4 **(8 Hours)**

THE PHASE PLANE METHOD: BASIC CONCEPTS, SINGULAR POINTS: Nodal Point, Saddle Point, Focus Point, Centre or Vortex Point, Limit Cycles.

CONSTRUCTION OF PHASE TRAJECTORIES: Construction by Analytical Method, Construction by Graphical Methods.

BASIC CONCEPTS & DERIVATION OFDESCRIBING FUNCTIONS: Dead-zone and Saturation, Relay with Dead-zone and Hysteresis, Backlash, Relay with Dead Zone, Relay with Hysteresis, Stability Analysis by Gain-phase Plot, Jump Resonance.

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

Text Books:

Discrete-Time Control System, by K.Ogata, 2nd edition (2009), PHI.
Control Systems Engineering, by I.J. Nagrath and M.Gopal., 5th Edition (2007 / 2009), New Age International (P) Ltd. Publishers.

Reference Books:

Design of Feedback Control Systems by Stefani, Shahian, Savant, Hostetter, Fourth Edition (2009), Oxford University Press.
Modern Control Systems by K.Ogata, 5th Edition (2010), PHI..
Modern Control Systems by Richard C. Dorf. And Robert, H.Bishop, 11th Edition (2008), Pearson Education Inc. Publication.
Control Systems (Principles & Design) by M.Gopal, 3rd Edition (2008), Tata Mc.Graw Hill Publishing Company Ltd.
Control Systems Engineering by Norman S.Nise, 4th Edition (2008), Wiley India (P) Ltd.
(2004), S. Chand Co. Ltd.
Problems and solutions in Control System Engineering by S.N. Sivanandam and S.N. Deepa, Jaico Publishing House

Title of the subject

Subject Code	**INDUSTRIAL ELECTRONICS**	L	T	P	C	QP
BECPE7034		**3**	**0**	**0**	**3**	

Pre -Requisite: power electronics

Course Educational Objective

CEO1: To understand the construction, working, and applications of various types of power electronic components.

CEO2: To acquire the knowledge about application based circuits such as fan regulator,photoelectric relay, AC/DC power controller, Polyphase rectifier, Inverters, etc.
CEO3: To enable the students for testing and troubleshooting the Industrial electronic circuitsandcomponents.

Course Outcome

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

CO1 Illustrate the construction, working, and applications of various types of power electronic components.
CO2 Troubleshoot inverter, chopper and cyclo-converters.
CO3 Use photoelectric devices in relevant and different types of timers in specific applications.
CO4 Draw schematic circuit for the single phase ac power control circuit using DIAC application.
CO5 Develop application oriented electronic circuits commonly used in the industries.
CO6 Maintain induction heating and dielectric heating equipment

UNIT:1 **8 Hours**

POWER SEMICONDUCTOR DEVICES Thyristor: Thyristor characteristics, Thyristor turn-on methods, Thyristor protection, Series and parallel operation of thyristors, Thyristor commutation; Characteristics of Diac and Triac; Power diode; Power transistor; Power MOSFET; IGBT.

UNIT:2 **10 Hours**

PHASE CONTROLLED CONVERTERS: Principle of phase control, Single-phase half-wave circuit with different types of load, Single-phase full-wave mid-point converter, Single-phase full-wave bridge converters, Single-phase semiconverter, Three-phase thyristor converters, Single-phase and three-phase dual converters.

UNIT:3 **8 Hours**

DC CHOPPERS: Principle of chopper operation and control strategies, Step-up and step-down choppers, Types of chopper circuits, Voltage-commutated chopper, Current-commutated chopper, Load commutated chopper.

UNIT:4 **12 Hours**

INVERTERS: Single-phase voltage source inverters, Modified McMurray half-bridge and full-bridge inverter, McMurray-Bedford half-bridge and full-bridge inverter, Pulse-width modulated inverters, Current source inverters, Series inverters, Parallel inverter.
INVERTERS Single-phase voltage source inverters, Modified McMurray half-bridge and full-bridge inverter, McMurray-Bedford half-bridge and full-bridge inverter, Pulse-width modulated inverters, Current source inverters, Series inverters, Parallel inverter.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books:

1. Power Electronics: Circuits, Devices and Applications by Muhammad H. Rashid; Pearson / PHI Publication.
2. Power Electronics by Dr. P. S. Bimbhra; Khanna Publishers.

Reference Books:

1. Power Electronics by P. C. Sen; Tata McGraw Hill Publication.
2. Power Electronics by C. W. Lander; McGraw Hill Publication.

Subject Code	**SPEECH & AUDIO PROCESSING**	L	T	P	C	QP
BECPE6042		3	0	0	3	

Pre -Requisite:Signals & Systems, Digital Signal Processing

Course Educational Objective

CEO1: To learn basic concepts of speech & audio processing.
CEO2: To study fundamentals and mathematical models in digital speech & audio processing.
CEO3: To develop time and frequency domain techniques for speech analysis.
CEO4: To study linear predictive analysis techniques for speech processing.

Course Outcome

At the end of the course students will be able to

CO1 Define speech production.
CO2 Discuss theory and models in speech & audio Processing.
CO3 Illustrate various techniques involved in collecting the features from the speech signal in both time and frequency domain.
CO4 Analyze the various techniques involved in speech and speaker detection.
CO5 Summarize the various speech compression techniques
CO6 Evaluate quantitative models of speech & audio Processing for various engineering applications and develop innovative design for practical applications in various fields

UNIT:1 **10 Hours**

Mechanics of speech- Speech production: Mechanism of speech production, Acoustic phonetics - Digital models for speech signals - Representations of speech waveform: Sampling speech signals, basics of quantization, delta modulation, and Differential PCM - Auditory perception: psycho acoustics.

UNIT:2 **12 Hours**

Timedomain methods for speech processing- Time domain parameters of Speech signal – Methods for extracting the parameters Energy, Average Magnitude, Zero crossing Rate – Silence Discrimination using ZCR and energy – Short Time Auto Correlation Function –Pitch period estimation using Auto Correlation Function.

UNIT:3

12 Hours

Frequency domain method for speech processing- Short Time Fourier analysis: Fourier transform and linear filtering interpretations, Sampling rates - Spectrographic displays - Pitch and formant extraction - Analysis by Synthesis - Analysis synthesis systems: Phase vocoder, Channel Homomorphicvocoder speech analysis: Cepstral analysis of Speech, Formant Estimation, Homomorphic and speech vocoder.

UNIT:4 **10 Hours**

Linear predictive analysis of speech- Basic Principles of linear predictive analysis – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm, Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis, VELP – CELP.

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

Text Books

Digital Processing of Speech signals, L.R.Rabiner and R.W.Schaffer, PrenticeHall 1979

Reference Books:

1. Discrete-Time Speech Signal Processing, Thomas F, Quatieri, Prentice Hall /Pearson Education, 2004.
Speech and Audio Signal Processing, Ben Gold and Nelson Morgan, John Wileyand Sons Inc., Singapore, 2004
3. Fundamentals of Speech Recognition, L.R. Rabiner and B. H. Juang, PrenticeHall, 1993.
4. Discrete Time Processing of Speech Signals, J.R. Deller, J.H.L. Hansen and J.G.Proakis, John Wiley, IEEE Press, 1999.
5. Speech Communication Human and Machine, Douglas O Shaughnessy.S BSPBOOKS PVT LTD, 2nd edition

MIXED SIGNAL DESIGN

Subject Code	L	T	P	C	QP
BAEPE 8013	3	0	0	3	

Pre -Requisite: Fundamental of Electronics devices, Network theory ,Analogue Electronic Circuit, Digital Electronics Circuit

Course Educational Objective

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

CEO2: To get a complete knowledge CMOS Logic circuits and their working principle.

CEO3: To analysis the switching actionultra-low power circuit design, error resilient circuit design, power management circuits and basic design of analog circuits.

CEO4: Familiar about the concept design different architectures in mixed signal mode.

Course Outcome

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

CO1 Describe relevant properties of analogue and digital signals and explain the consequences of these for high speed digital and mixed signal designs with switching action.

CO2 Demonstrate understanding of common data converter parameters

CO3 Analyze performance for designing mixed-signal building blocks including comparators and data converters

CO4 Use low-voltage, low-power design techniques for mixed-signal CMOS ICs.

CO5 Identify the interactions between process parameters, device structures, circuit performance, and system design.

CO6 Analyze the CMOS circuits in the device modelling.

UNIT:1 **12 Hours**

1.Analog and discrete-time signal processing, introduction to sampling theory; Basic sampling circuits for analog signal sampling, performance metrics of sampling circuits, different types of sampling switches. Sample-and-Hold Architectures-Open-loop & closed-loop architectures, open-loop architecture with miller capacitance, Multiplexed-input architectures, recycling architectureAnalog continuous-time filters: passive and active filters;
Basics of analog discrete-time filters and Z-transform

UNIT:2 **08 Hours**

Switched-capacitor filters-Non idealities in switched-capacitor filters;Switched-capacitor filter architectures; Switched-capacitor filter applications Integrator Based Filters Low Pass filters, active RC integrators, MOSFET -C integrators, transconductance-c integrator, discrete time integrators. Filtering topologies -bilinear transfer function and bi quadratic transfer function

UNIT:3 **10 Hours**

Basics of data converters; Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACsMixed-signal layout, Interconnects and data transmission; Voltage-mode signaling and data transmission; Current-mode signaling and data transmission.

UNIT:4. **10 Hours**

Introduction to frequency synthesizers and synchronization;
Basics of PLL,. Characterization of a comparator, basic CMOS comparator design, analog multiplier design, PLL -simple PLL, Analog PLLs; Digital PLLs; DLLs charge-pump PLL, applications of PLL.

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

Text Books

David A. Johns, Ken Martin, "Analog Integrated Circuit Design", John Wiley and Sons, 1997.
Design of analog CMOS integrated circuits by Behzad Razavi, McGraw-Hill, 2003.
CMOS circuit design, layout and simulation by R. Jacob Baker, Revised second edition, IEEE press, 2008.
CMOS Integrated ADCs and DACs by Rudy V. dePlassche, Springer, Indian edition, 2005.
Electronic Filter Design Handbook by Arthur B. Williams, McGraw-Hill, 1981.

Ref. Books

Design of analog filters by R. Schauman, Prentice-Hall 1990 (or newer additions)
An introduction to mixed-signal IC test and measurement by M. Burns et al., Oxford university press, first Indian edition, 2008.
.R. Jacob Baker, "CMOS Mixed-Signal Circuit Design", Wiley Inter-Science, 2003.
.R. Gregorian, G. C. Temes, "Analog MOS Integrated Circuits for Signal Processing", John Wiley and Sons, 1986.
.P.E. Allen, Doug Holberg, "CMOS Analog Circuit Design", Oxford University Press, 2011

TELECOMMUNICATION SYSTEM MODELING AND SIMULATION

Subject Code	L	T	P	C	QP
BECPE6043	**3**	**0**	**0**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1: To enable the students in understanding the various aspects of simulation methodology and performance.
CEO2: To model different types of communication systems & channels and process them.
CEO3: To enable the students in understanding and interpreting results using case studies.

Course Outcome

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

CO1 Recognize and mathematically model physical phenomena.
CO2 Understand and describe the various simulation techniques.
CO3 Apply the knowledge of the different simulation techniques for designing a communication system or channel.

CO4 Simulate the phenomena so as to depict the characteristics that may be observed in a real experiment.
CO5 Formulate discrete memory less channel models.
CO6 Evaluate the performance so as to match a realistic scenario.

UNIT:1 SIMULATION METHODOLOGY (9 Hours)

Introduction, Aspects of methodology, Performance Estimation, Simulation sampling frequency, Low pass equivalent simulation models for bandpass signals, Multicarrier signals, Non-linear and time varying systems, Post processing – Basic graphical techniques and estimations.

UNIT:2 RANDOM SIGNAL GENERATION & PROCESSING (10 Hours)

Uniform random number generation, Mapping uniform random variables to an arbitrary pdf, Correlated and Uncorrelated Gaussian random number generation, PN sequence generation, Random signal processing, Testing of random number generators.

UNIT:3 MONTE CARLO SIMULATION (8 Hours)

Fundamental concepts, Application to communication systems, Monte Carlo integration, Semi-analytic techniques, Case study: Performance estimation of a wireless system

UNIT:4 ADVANCED MODELS & SIMULATION TECHNIQUES (13Hours)

Modeling and simulation of non-linearities : Types, Memoryless non-linearities, Non-linearities with memory, Modeling and simulation of Time varying systems : Random process models, Tapped delay line model, Modelling and simulation of waveform channels, Discrete memoryless channel models, Markov model for discrete channels with memory, Tail extrapolation, pdf estimators, Importance Sampling methods, Case study: Simulation of a Cellular Radio System.

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

Text Books:

1. William.H.Tranter, K. Sam Shanmugam, Theodore. S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems Simulation, Pearson Education (Singapore) Pvt. Ltd, 2004.
2.M.C. Jeruchim, P.Balaban and K. Sam Shanmugam, Simulation of Communication Systems: Modeling, Methodology and Techniques, Plenum Press, New York, 2001

Reference Books:

1.Averill.M.Law and W. David Kelton, Simulation Modeling and Analysis, McGraw Hill Inc., 20
2. Geoffrey Gorden, System Simulation, Prentice Hall of India, 2nd Edition, 1992.
3. Jerry Banks and John S. Carson, Discrete Event System Simulation, Prentice Hall of India, 1984.

Title of the subject

Subject Code		L	T	P	C	QP
BCSOE7053	**Soft Computing**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite:

Course Educational Objective

CEO1: To introduce artificial neural networks, evolutional computation and fuzzy systems

CEO2: To make them understand the supervised and unsupervised neural networks

CEO3: Will be introduced to genetic algorithms.

Course Outcome

CO1 Analyse and compare the supervised and unsupervised neural networks.

CO2 Implement genetic algorithms.

CO3 Analyse and design fuzzy systems

UNIT:1 **(10 Hours)**

Neural Networks: Fundamentals of Neural Networks: Models of an artificial Neuron, Neural Network Architecture, Learning methods

Back Propagation Networks: Architecture of a Back propagation Network: back propagation,

Learning Effect of Tunning parameters of the Back propagation Neural Network, variation of standard Back Propagation Algorithms..

UNIT:2 **(10 Hours)**

Associative memory: Auto correlators, Kosko's Discrete BAM, Exponential BAM, Associative memory for Real-coded Pattern Pairs, Applications.

Adaptive Resonance Theory: ART1, ART2, Applications

UNIT:3 **(10 Hours)**

Fuzzy Logic:

Fuzzy set theory: crisp sets, fuzzy sets, crisp relations, fuzzy relations, Fuzzy Systems: Crisp

logic predicate logic, fuzzy logic, fuzzy Rule based system, Defuzzification Methods.

Genetic Algorithms:

Fundamentals of genetic algorithms: Encoding, Fitness functions, Reproduction.

Genetic Modeling:

Cross cover, Inversion and deletion, Mutation operator, Bit-wise operators, Bitwise operators used in GA. Convergence of Genetic algorithm. Applications, Real life Problems.

UNIT:4 **(10 Hours)**

Hybrid Systems:

Hybrid system, neural Networks, fuzzy logic and genetic algorithms hybrids.Genetic Algorithm based Back propagation Networks: GA based weight determinationapplications: Fuzzy Back Propagation Networks, Fuzzy Associative Memories: SingleAssociation FAM, Fuzzy Hels FAMS, Fuzzy logic controlled genetic Algorithms softcomputing tools, Fuzzy constraints, GA in fuzzy logic controller design, Applications.

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

Text Books:

1. Neural Networks, Fuzzy Logic, and Genetic Algorithm (Synthesis and Application) S.Rajasekaran, G.A. Vijayalakshmi Pai, PHI

Reference Books:

1. Neuro Fuzzy and Soft Computing, J.S.R. JANG, C.T.Sun, E.Mitzutani, PHI

Advanced Lab II

Subject Code	L	T	P	C	QP
	3	0	0	3	

Pre -Requisite: Micro-Controllers, I/O Devices, Wireless Sensor Networks
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 Smart Application Implementation as per the industry requirement

CO2 Professional approach in projects development

CO3 Projects done here are trying to solve problems of various departments like health, food, emergency services, automation etc.

CO4 A professional approach to documentation, project completion and presentation.

CO5 Exposure to outside world
CO6 A practical implementation using basic inputand output devices.
How to connect to two types of network: an open network (without a password) and encrypted network (with password)
How to make 2 types of access point (hot spot): one with password and one without password
How to find IP and host name
How to Run a local web server
How make your Android App that controls an LED. You will use the online tool App Inventor
How to make your Androind App that gets data from a sensor connected to NODEMCU
How to make 2 NODEMCU communicate together. One will run as a Server, so listening to request. The other will be a client so sending request.
How to monitor a network of sensors conntected to NODEMC
How to make a program that scans the available machine or board connected to the network
How to make a WIFI network scanner
How to make a web page embedded into a NODEMCU to control an LED to the board
How sending data to the IOT platform thingspeak
How to send Tweet to Twitter
How to see the NTP (Network time protocol) or how to get time from the Internet

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

Text Books :
1. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press – 2012.
2. 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.

Satellite communication

Subject Code	L	T	P	C	QP
BECPE8011	**3**	**0**	**0**	**3**	-

Pre -Requisite:Electromagnetics , Digital Communications

Course Educational Objective

CEO1: To calculate the received carrier power at the input of earth station receiver or satellite transponder.

CEO2: To design domestic satellite system using small earth station.

Course Outcome

CO1 Define And Describe the dynamics of the satellite.

CO2 Estimate orbital parameters, look angles and learn the operation of launching method.

CO3 Illustrate the commands monitoring power systems and developments of antennas.

CO4 Classify different multiple access techniques like TDMA, CDMA, FDMA, DAMA.

CO5 Design antennas of Uplink and down link Frequency of Satellite real time applications

CO6 Judge the impacts of GPS, Navigation for tracking.

Unit:1 (**12 hrs**)

BASICSOF SATELLITE ORBITS: Frequency allocations for Satellite Services, Orbital mechanics and parameters, look angledetermination, Launches and Lunch vehicle, Orbital effects in communication system performance. Satellite Subsystem:Attitude and orbit control system (AOCS), TT&C, Description of spacecraft System; Transponders.

SATELLITE LINK DESIGN: Basics of transmission theory, system noise temperature and G/T ratio,Uplink and Downlink design, design of satellite links for specified (C/N) performance.

Unit: 2 (**10 hrs**)

SATELLITE ACCESSES: Multiple access techniques for satellite links, Preassigned FDMA, Demand Assigned FDMA, TDMA, Preassigned TDMA, Demand-assigned TDMA, Satellite-Switched TDMA, Code Division Multiple Access; Estimating Channel requirements, SPADE, Random access.

SATELLITE MOBILE AND SPECIALIZED SERVICES: Introduction, Satellite Mobile Services, VSATs, Global Positioning Satellite System (GPS). DBSTV System Design.

Unit:3 **(11hrs)**

PROPAGATION ON SATELLITE: Introduction, Quantifying attenuation and depolarization, Atmospheric Losses, Ionosphere Effects , Tropospheric Scintillation, hydrometric & non hydrometric effects, ionosphere effects, rain and ice effects.

SATELLITE ANTENNAS: Basic Antennas Theory –Horn, Parabolic, Dipole; Antenna relationships:Gain, pointing loss, Directivity, Efficiency.

Unit:4 **(7 hrs)**

EARTH STATION TECHNOLOGY: Design of large antennas – Cassegrain antennas,optimizing gain of large antenna, antenna temperature.

DESIGN OF SMALL EARTH STATION ANTENNAS: Front fed paraboloid reflector antennas, offset fedantennas, beam steering, Global Beam Antenna, equipment for earth station.

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

Text Books

Satellite Communication, T. Pratt, C. Bostian, John Wiley Co, 2nd Edition.
Satellite Communication, Principles & Applications, R.N.Mutagi, Oxford University Press, 1st Edition, 2016

Ref. Books

Digital Communication with Satellite and Fiber Optic Application, HarlodKolimbins, PHI
Satellite Communication, Robert M. Gagliardi, CBS Publishers
Satellitte Communication Systems, Richharia. BSP BOOKS PVT LTD.
Satellitte Communication Engg., MichealKolawole, BSP BOOKS PVT LTD

Title of the subject

Subject Code	**MICRO-ELECTRO MECHANICAL SYSTEM**	L	T	P	C	QP
BAEOE6053		3	0	0	3	

Pre -Requisite:

Course Educational Objective

CEO1: A sound knowledge of the fundamental scientific principles involved in the operation, design, and fabrication of integrated circuits.

CEO2: A comprehensive understanding of relevant technologies such as integrated circuit process integration and manufacturing.

CEO3: Application of engineering principles to the design and development of current and future semiconductor technologies.

CEO4: A breadth of knowledge, including the multidisciplinary nature of microelectronic engineering as well as the broad social, ethical, safety, and environmental issues within which engineering is practiced.

Course Outcome

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

CO1 Recognize the physical, chemical, biological, and engineering principles involved in the design and operation of current & future micro devices.

CO2 Illustrate the limitations and current challenges in microsystems technology.

CO3 Apply new ideas and applications for MEMS devices.

CO4 Inspect the situations where MEMS sensors and actuators would be ideal for application to various products.

CO5 Propose diverse fabrication methods to construct MEMS.

CO6 Evaluate MEMS platform for a wide variety of applications in construction and processing techniques.

UNIT:1 **10 Hours**

INTRODUCTION TO MEMS: Smart materials, Structures and systems, Integrated Microsystem, Applications.

MICROMACHINING TECHNIQUES: Silicon as material for micromachining, Photolithography, thin film deposition, doping, Etching: wet and dry etching, surface and bulk micromachining, Wafer bonding, packaging.

UNIT:2 **12 Hours**

MICROSYSTEM MODELING AND DESIGN: Mechanics of deformable bodies, Energy method, Estimation of stiffness and damping for different micro-structures, Modeling of electromechanical systems, Pull-in voltage.

UNIT:3 **14 Hours**

MEMS APPLICATIONS: MECHANICAL SENSORS AND ACTUATORS: Piezoresistive pressure sensors, MEMS capacitive accelerometer, Gyroscopes, Piezoelectric actuators**.**
Optical: Micro-lens, Micro-mirror, Optical switch

RADIO FREQUENCY MEMS: Inductor, Varactor, Filter, and Resonator.
Microfluidics: Capillary action, Micro pumping, Electro wetting, Lab-on-a-chip.
Teaching Methods: Chalk& Board/ PPT/Video Lectures.

Text Books:

G.K. Ananthsuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Atre: Micro and Smart Systems, Wiley India, New Delhi, 2010.
N.P. Mahalik: MEMS, Tata McGraw-Hill, New Delhi, 2007. Reference.

Reference Books:

T. Hsu: MEMS and Microsystems: Design and Manufacture, Tata McGraw-Hill, New Delhi, 2002.

High Speed Electronics

Subject Code	L	T	P	C	QP
BECPE8013	**3**	**0**	**0**	**3**	

Pre -Requisite: Physics of Semiconductor Devices

Course Educational Objective

CEO1: Characterize the governingparametersdeciding the speed of the semiconductor devices

CEO2: Familiar with designing of Heterostructure Devices to operate in High frequency

CEO3: Design current voltage models for high speed devices like MESSFETs, SOI MESFETs

CEO4: Develop of high speed circuit using advance semiconductor devices

Course Outcome

At the end of the course students will be able to

CO1 Describe the physical characteristics, such as electronic structures and optical and transport properties of semiconductors and I-V characteristics of semiconductor devices.

CO2 Understand the design and operation of high speed semiconductor devices

CO3 Apply fundamental principles and processes to III –V binary and ternary compound semiconductor devices

CO4 Analyze&model some semiconductor properties, processes and device characteristics using equations

CO5 Evaluate the device characteristics in terms of the material properties and/or structural parameters.

CO6 Design advanced semiconductor devices like HEMT,SOI MESFET and analysis of their current-voltage models

UNIT:1 **12Hours**

1. Important parameters governing the high speed performance of devices and circuits:-

Transit time of charge carriers, junction capacitances, ON-resistances and their dependence on the device geometry and size, carrier mobility, doping concentration and temperature. Contact resistance and interconnection/interlayer capacitances in the Integrated Electronics Circuits.

2.Silicon based MOSFET and BJT circuits for high speed operation and their limitations:-

Emitter coupled Logic (ECL) and CMOS Logic circuits with scaled down devices. Silicon On Insulator (SOI) wafer preparation methods and SOI based devices and SOI CMOS circuits for high speed low power applications.

UNIT:2 **08Hours**

3.Materials for high speed devices and circuits:-

Merits of III –V binary and ternary compound semiconductors (GaAs, InP, InGaAs, AlGaAs ETC.), silicon-germanium alloys and silicon carbide for high speed devices, as compared to silicon based devices. Brief outline of the crystal structure, dopants and electrical properties such as carrier mobility, velocity versus electric field characteristics of these materials. Material and device process technique with these III-V and IV – IV semiconductor

UNIT:3. **12Hours**

4.Metal semiconductor contacts and Metal Insulator Semiconductor and MOS devices:

Native oxides of Compound semiconductors for MOS devices and the interface state density related issues. Metal semiconductor contacts, Schottky barrier diode. Thermionic Emission model for current transport and current-voltage (I-V) characteristics. Effect of interface states and interfacial thin electric layer on the Schottky barrier height and the I-V characteristics

5.**Metalsemiconductor Field Effect Transistors (MESFETs):**

Pinch off voltage and threshold voltage of MESFETs. D.C. characteristics and analysis of drain current. Velocity overshoot effects and the related advantages of GaAs, InP and GaN based devices for high speed operation. Sub threshold characteristics, short channel effects and the performance of scaled down devices.

UNIT:4 **12Hours**

6.High Electron Mobility Transistors (HEMT):

Hetero-junction devices. The generic Modulation Doped FET(MODFET) structure for high electron mobility real1ization. Principle of operation and the unique features of HEMT. InGaAs/InP HEMT structures.

7.HBT: Hetreojunction Bipolar Transistor

8.High speed Circuits:

GaAs Digital Integrated Circuits for high speed operation- Direct Coupled Field Effect Transistor Logic (DCFL), Schottky Diode FET Logic (SDFL), Buffered FET Logic(BFL). GaAs FET Amplifiers. Monolithic Microwave Integrated Circuits (MMICs)

9.High Frequency resonant – tunneling devices. Resonant-tunneling hot electron transistors and circuits.

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

Text Books:

1. C.Y. Chang, F. Kai, GaAs High-Speed Devices: Physics, Technology and Circuit Applications
Wiley
2. Cheng T. Wang, Ed., Introduction to Semiconductor Technology: GaAs and Related Compounds,
John Wiley & Sons,
3. David K. Ferry, Ed., Gallium Arsenide Technology, Howard W. Sams& Co., 1985
4. Avishay Katz, Indium Phosphide and Related materials: Processing, Technology and Devices,
Artech House, 1992.
5. S.M. Sze, High Speed Semiconductor Devices, Wiley (1990) ISBN 0-471-62307-5

Ref. Books:

1. Ralph E. Williams, Modern GaAs Processing Methods, Artech (1990), ISBN 0-89006-343-5,
2. Sandip Tiwari, Compound Semiconductor Device Physics, Academic Press (1991), ISBN 0-12-
691740-X
3. G.A. Armstrong, C.K. Maiti, TCAD for Si, SiGe and GaAs Integrated Circuits, The Institution of
Engineering and Technology, London, United Kingdom, 2007,ISBN 978-0-86341-743-6.
4. John H. Davies, " The Physics of Low-Dimensional Semiconductors an Introduction", Cambridge University Press, 1998.

CO - PO Matrix of Course

Wavelets Transforms

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
C1	2	1	2	1	3	1	1	-	1	1	-	2	2	2	1
C2	3	2	2	1	2	2	1	1	2	2	2	2	3	2	2
C3	1	2	3	2	2	-	-	-	1	1	-	2	2	3	2
C4	2	3	3	3	3	1	2	2	2	2	-	3	3	3	2
C5	2	2	3	1	3	2	1	2	-	2	-	1	2	2	2
C6	3	2	3	3	3	2	1	1	2	3	2	2	2	3	3
Average	2.16	2	2.67	1.87	2.67	1.6	1.2	1.5	1.33	1.87	2	2	2.33	2.5	2

Subject Code	L	T	P	C	QP
BECPE 8014	3	0	0	3	

Pre-Requisites –Signals & Systems, Digital Signal Processing

Course Educational Objective

CEO1: Develop an understanding of the theoretical underpinnings of wavelet transforms and their applications.
CEO2: Learn how to use a computer algebra system for mathematical investigations, as a computational and visualization aid, and for the implementation of mathematical algorithms
CEO3: Get a flavor of the ideas and issues involved in applying mathematics to a relevant engineering problem
CEO4: Be able to give and defend a mathematical presentation to a group of your peers

Course Outcome
At the end of the course students will be able to

CO1 Define the terminology that are used in the wavelets literature

CO2 Understand how to use the modern signal processing tools using signal spaces, bases, operators and series expansions

CO3 Explain the concepts, theory, and algorithms behind wavelets from an interdisciplinary perspective that unifies harmonic analysis (mathematics), filter banks (signal processing), and multire solution analysis (computer vision)..

CO4 Apply wavelets, filter banks, and multiresolution techniques to a problem at hand, and justify why wavelets provide the right tool.

CO5 Evaluate Multiresolution Techniques for different Data Compression technique

CO6 Design Wavelet transform technique for signal and image processing and other related engineering Fields

Unit-I

Continuous Wavelet Transform Introduction, Continuous-time wavelets, Definition of the CWT, the VWT as a Correlation, Constant-Factor Filtering Interpretation and Time-Frequency Resolution, the VWT as an Operator, Inverse CWT, Problems.
Introduction to Discrete Wavelet Transform And Orthogonal Wavelet Decomposition: Introduction, Approximation of Vectors in Nested Linear Vector Subspaces, Examples of an MRA, Problems.

Unit-II

MRA, Orthonormal Wavelets, And Their Relationship To Filter Banks: Introduction, Formal Definition of an MRA, Construction of General Orthonormal MRA, a wavelet Basic for the MRA, Digital Filtering Interpretation, Examples of Orthogonal Basic Generating Wavelets, Interpreting Orthonormal MRAs for Discrete-Time signals, Miscellaneous Issues Related to PRQME Filter Banks, generating Scaling Functions and wavelets from Filter Coefficient, Problems

Unit-III

Wavelet Transform And Data Compression: Introduction, Transform Coding, DTWT for Image Compression, Audio Compression, And Video Coding Using Multiresolution Techniques: a Brief Introduction.
Other Application 0f Wavelet Transforms: Introduction, Wavelet denoising speckles Removal, Edge Detection and Object Isolation, Image Fusion, Object Detection by Wavelet Transform of Projections, Communication application

Unit-IV

Wavelet Packets and M-Band Wavelets: Wavelet Packet Analysis: Signal representation using Wavelet Packet Analysis, Selection of best basis, Introduction of M-Band wavelet system, Signal representation using MBand wavelet systems. Applications of Wavelets: Applications of wavelets in signal and image processing and other related engineering Fields

Teaching Method(s): Chalk & Board/ PPT/Video Lectures/ MOOC/ Internship/Industry Guest Lecture/ Invited Guest lecture/ Demonstration. etc.(can be chosen one or many)

Books Recommended

1. James S. Walker, “A Primer on Wavelets and their Scientific Applications”, CRC Press, (1999).
2. Rao, “Wavelet Transforms”, Pearson Education, Asia.
3. C. Sidney Burrus, Ramesh A. Gopinath, “Introduction to Wavelets and Wavelets Transforms”,
Prentice Hall, (1997).

Subject Code	**DIGITAL IMAGE AND VIDEO PROCESSING**	L	T	P	C	QP
BECPE 7041		**3**	**0**	**0**	**3**	

Pre -Requisite: Concept of Digital Signal Processing

Course Educational Objective

CEO1: Representation of digital images and video in the spatial (pixel) and frequency domains, and learn common digital video formats.

CEO2: Understand basic image and video filtering operations and fundamentals of image Compression.

CEO3: Understand fundamentals of video compression and recent image and video compression standards

CEO4: Analyze and interpret the results of image processing methods and algorithms

Course Outcome

At the end of the course students will be able to

CO1 Define images and videos as 2-dimensional (2D) and 3-dimensional (3D) signals and their analog/digital dichotomy.

CO2 Discuss characteristics of an image depending on its placement over the electromagnetic spectrum.

CO3 Illustrate image and video enhancement to improve the appearance and usefulness of an image or video.

CO4 Analyze image and video compression technique to achieve lossless compression.

CO5 Evaluate video compression with an emphasis on motion-compensated hybrid video encoding and video compression standards.

CO6 Create processors for image and video applications in real field.

UNIT:1 **(10hrs)**

Fundamentals – Steps in digital image processing, sampling and quantization, relationship between pixels, imaging geometry

Image Transforms – Fourier Transform, Discrete Fourier Transform, Fast Fourier Transform,Discrete Cosine Transform, Walsh Transform, Hadamard Transform, Hotelling Transform.

UNIT:2 **(12hrs)**

Image Enhancement – Point processing, spatial filtering (smoothing and sharpening filters), enhancement in frequency domain.

Filtering in the Frequency Domain: preliminary concepts, 2D DFT and its properties, basic filtering in the frequency domain, image smoothing and sharpening.

UNIT:3 **(12hrs)**

Image Restoration and Reconstruction: Image restoration/degradation model, noise models,restoration in the presence of noise only, estimating the degradation function.

Color Image and Video Processing: Color models, Color transformation, Pixel-based model, Space-frequency model, Mosaic creation. Geometrical model, Video restoration, Region-based model, Shot detection, object tracking.

UNIT:4 **(8hrs)**

Wavelets and Multi-resolution Processing: multiresolution expansions, wavelet transforms inone and two dimension.

Image Compression: Fundamentals, Some basic compression methods

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

Text Books

1) Digital Image Processing, R.C. Gonzalez, R.E. Woods, Pearson Education , 3rd Edition,

2007
2) Digital Image Processing, S. Sridhar, Oxford University Press,2011
3) Digital Image Processing And Analysis, B. Chanda, Dutta D. Majumder ,PHI

Reference Books

1) Digital Image Processing using MATLAB, Rafael C. Gonzalez, Richard E. Woods Pearson Education, Inc., Seventh Edition, 2004.
2) Digital Image Processing, William K. Pratt, John Wiley, New York, 2002

OPTICAL COMMUNICATION AND NETWORKING

Subject Code	L	T	P	C	QP
BECPE8022	**3**	**0**	**0**	**3**	**A**

Pre -Requisite:Knowledge of physics, optical communication & computer networks required.

Course Educational Objective

CEO1: To expose the students to the basics of signal propagation through optical fibers, fiber impairments, components and devices and system design.
CEO2: To provide students with the design and operating principles of optical communication systems and networks.
CEO3: To discuss about digital transmission and its associated parameters on system performance.

Course Outcome

CO1 Recognize the principles fiber-optic communication, the components and the bandwidth advantages.
CO2 Understand the properties of the optical fibers and optical components.
CO3 Discuss the channel impairments like losses and dispersion.
CO4 Compare the operation of lasers, LEDs, and detectors.
CO5 Analyze system performance of optical communication systems.
CO6 Design optical networks and understand non-linear effects in optical fibers.

UNIT:1 **9 Hours**

Optical Fiber Waveguides: Introduction; Ray theory transmission - Total internal reflection, Acceptance angle, Numerical aperture, Skew rays; Electromagnetic mode theory for optical propagation – Electromagnetic waves, Modes in planar guide, phase and group velocity; Cylindrical fiber, Single-mode fibers.

UNIT:2 **9 Hours**

Transmission Characteristics of Optical Fibers: Attenuation; Material absorption losses in silica glass fibers; Linear and Nonlinear scattering losses; Fiber bend losses; Mid-infrared and far-infrared transmission; Intra and inter modal dispersion; Over all fiber dispersion; Polarization, Non linear effects.
Optical Fiber Connections: Fiber alignment and joint loss; Fiber splices; Fiber connectors; Expanded beam connectors; Fiber couplers.

UNIT:3 **10 Hours**

Optical Sources and Detectors: Optical Sources: Light Emitting Diodes, Laser Diodes; Optical Detectors: PIN Photo detectors; Avalanche Photodiodes; Photo detector Noise - Noise sources, Signal-to-noise ratio, Detector response time.
Optical Receiver Operations: Fundamental receiver operation - Pre amplifiers, Error sources, Receiver configuration, Probability of error; Quantum limit.

UNIT:4 **12 Hours**

Optical Fiber Measurements: Fiber attenuation measurements; Fiber dispersion measurements, Fiber refractive index profile measurements, Fiber cutoff wavelength measurements, Fiber numerical aperture measurements, Fiber diameter measurements.

Optical Networks: Optical network concepts; Optical network transmission modes, layers and protocols; Wavelength routing networks; Optical switching networks; Optical network deployment; Optical Ethernet; Network protection, restoration and survivability.

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

Text Books:

Optical Fiber Communication, John M. Senior, Pearson Education, Second Edition, 2007.
Optical Fiber Communication, Gerd Keiser, McGraw Hill, Third Edition, 2000.
Fiber Optics and Optoelectronics, R.P. Khare, Oxford University Press, 2007.

Reference Books:

Optical Communication System, J. Gower, Prentice Hall of India, 2001.
Optical Networks, Rajiv Ramaswami and Kumar Sivarajan,M. K. Publication,2nd edition.
Fiber-optic communication systems, Govind P. Agrawal, John Wiley & sons, third edition, 2004.
Optical Communication Networks, Biswanath Mukherjee, McGraw Hill Publication, 2000.