Course Structure &Syllabus

of

B. Tech. Programme

in

Electronics & Telecommunication Engineering

Academic Year – 2019-20

VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, ODISHA

Burla, Sambalpur-768018, India

www.vssut.ac.in

VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, BURLA, ODISHA
DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING

VISION

Developing new ideas in the field of communication to enable students to learn new technologies, assimilate appropriate skills and deliver meaningful services to the global society and improve the quality of life by training them with strength of character, leadership and self-attainment.

MISSION

M1. Imparting futuristic technical education to the students.

M2. Promoting active role of Industry in student curriculum, projects, R&D and placements.

M3. Organizing collaborative academic and non-academic programmes with institutions of national and international repute for all round development of students.

M4. Organizing National and International seminars and symposium for exchange of innovation, technology and information.

M5. Expanding curricula to cater to demands of higher studies in internationally acclaimed institutes.

M6. Preparing students for promoting self-employment.

M7. Develop the department as a center of excellence in the field of VLSI and communication technology by promoting research, consultancy and innovation.

PROGRAM EDUCATIONAL OBJECTIVES

1. The main objective of Electronics and Telecommunication Engineering Programme is the upliftment of students through quality technical education.
2. These technocrats should be able to apply basic and contemporary science, engineering, experimentation skills to identifying software / hardware problems in the industry and academia and be able to develop practical solutions to them.
3. The passing out graduates of the Program should be able to establish themselves as successful practicing professionals in Technology and sustain a bright career in related areas.
4. The graduates should be able to use their skills with a strong base to prepare themselves for higher learning.
5. Developing problem analysis and solving capability through industrial training and projects.
6. Developing communication skills and interpersonal skills and preparing them for providing self-Employments.

PEO-MISSION MATRIX

	M1	M2	M3	M4	M5	M6	M7
PEO1	**3**	**3**	**3**	**2**	**3**	**3**	**2**
PEO2	**3**	**3**	**2**	**3**	**3**	**3**	**2**
PEO3	**3**	**3**	**3**	**3**	**2**	**3**	**3**
PEO4	**3**	**3**	**2**	**3**	**3**	**3**	**2**
PEO5	**3**	**3**	**3**	**3**	**2**	**3**	**3**
PEO6	**3**	**2**	**3**	**3**	**3**	**2**	**3**

PROGRAM OUTCOMES

PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**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.
PO3	**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.
PO4	**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.
PO5	**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.
PO6	**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.
PO7	**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.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**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.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and 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.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

PSO1	Apply the knowledge of electronic circuits, analog and digital communication, wireless communication, radar engineering and antenna systems to solve complex engineering problems in the discipline of Electronics and Telecommunication Engineering
PSO2	Develop suitable techniques and cutting-edge engineering hardware and software tools in Electronics and Telecommunication Engineering to solve practical problems.
PSO3	Aware of the impact of professional Electronics and Telecommunication Engineering solutions on social, economic, environmental and technological sustainability.

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COURSE STRUCTURE FIRST SEMESTER FIRST YEAR (THEORY)				
Sl. No	Course Code	Subject	Contact Hrs. L-T-P	Credits
1	BMA2101	Mathematics-I	3-1-0	4
2	BCH2101	Chemistry	3-0-0	3
3	BEC2101	Basic Electronics	3-0-0	3
4	BCS2191	Programming for Problem Solving	3-0-0	3
5	BCE2102	Basic Civil Engg.	3-0-0	3
SESSIONALS				
1	BCH2191	Chemistry Lab	0-0-3	1.5
2	BEC2191	Basic Electronics Lab	0-0-3	1.5
3	BCS2191	Programming Lab	0-0-3	1.5
4	BCE01002	Engineering Graphics & Design	0-0-3	1.5
NON-CREDIT				
1	BNC01001	Induction Programme and participation in Clubs/Societies	0-0-0	0
Total			15-1-12	22

COURSESTRUCTURE SECOND SEMESTER FIRSTYEAR (THEORY)				
Sl. No	Course Code	Subject	Contact Hrs. L-T-P	Credits
1	BMA2201	Mathematics - II	3-1-0	4
2	BHU2191	English For Business Communication	3-0-0	3
3	BPH2101	Physics	3-0-0	3
4	BEE2101	Basic Electrical Engg.	3-0-0	3
5	BME2101	Engineering Mechanics	3-0-0	3
SESSIONALS				
1	BPH2191	Physics Laboratory	0-0-3	1.5
2	BEE2191	Basic Electrical Engg. Lab	0-0-3	1.5
3	BHU2191	Business Communication Skills Lab	0-0-3	1.5
4	BME2191	Workshop &Manufacturing Practices	0-0-3	1.5
NON-CREDIT				
1	BNC02001	NSS/NCC/Yoga	0-0-0	0
Total			15-1-12	22

COURSESTRUCTURE THIRDSEMESTER SECONDYEAR (THEORY)				
Sl. No	Course Code	Subject	Contact Hrs. L-T-P	Total Credits
1	BMA2301	Math-III	3-1-0	4
2	BEC2307	Network Theory	3-0-0	3
3	BEC2305	Analog Electronics Circuit	3-0-0	3
4	BEC2306	Signals & Systems	3-0-0	3
5	BHU2303	Economics for Engineers	2-0-0	3
SESSIONAL				
1	BEC2391	Analog Electronics Circuit Lab	0-0-3	1.5
2	BEC2396	Network Theory Lab	0-0-3	1.5
3	BEC2395	Signals & Systems Lab	0-0-3	1.5
4	BEC2393	Simulation Lab-I	0-0-3	1.5
NON-CREDIT				
1	BNC03001	Essence of India Traditional Knowledge/ Environmental Sciences	0-0-0	0
TOTAL			14-1-12	22

COURSE STRUCTURE FOURTH SEMESTER SECONDYEAR (THEORY)				
SI. No	Course Code	Subject	Contact Hrs. L-T-P	Credit
1	BEC2409	Digital System Design	3-1-0	4
2	BEC2406	Principles of Analog & Digital Communication	3-0-0	3
3	BEC2407	Advanced Electronics Circuit	3-0-0	3
4	BEC2408	EMFT & Transmission Lines	3-0-0	3
5	BHU2301	Organizational Behavior	3-0-0	3
SESSIONALS				
6	BEC2494	Digital System Design Lab	0-0-3	1.5
7	BEC2498	Advanced Electronics Circuits Lab	0-0-3	1.5
8	BEC2499	Analog & Digital Communication Lab	0-0-3	1.5
9	BEC2496	Design & Testing Lab	0-0-3	1.5
NON-CREDIT				
1	BNC04001	Environmental Sciences/ Essence of India Traditional Knowledge	0-0-0	0
2	BNC04002	Summer Internship/ Training	0-0-0	0
Total			14-1-12	22

COURSE STRUCTURE FIFTH SEMESTER THIRDYEAR (THEORY)				
SI. No	Course Code	Subject	Contact Hrs. L-T-P	Credit
1	BEC2507	Microprocessor & Microcontroller	3-0-0	3
2	BEC2506	Integrated Circuits & Systems	3-0-0	3
3	BEC2503	Digital Signal Processing	3-0-0	3
4		Professional Elective -I	3-0-0	3
5		Open Elective -I	3-0-0	3
6		Professional Ethics, Professional Law &Human Values / Financial Management, Costing, Accounting, Balance Sheet & Ratio Analysis	2-0-0	2
SESSIONAL				
1	BEC2595	Microprocessor & Microcontroller Lab.	0-0-3	1.5
2	BEC2596	Integrated Circuits & Systems Lab.	0-0-3	1.5
3	BEC2593	Digital Signal Processing Lab.	0-0-3	1.5
Total			17-0-9	21.5

COURSE STRUCTURE SIXTHSEMESTER THIRDYEAR (THEORY)				
SI. No	Course Code	Subject	Contact Hrs. L-T-P	Credit
1	BEC2603	Microwave Engineering	3-0-0	3
2	BEC2606	Wireless & Mobile Communication	3-0-0	3
3		Professional Elective -II	3-0-0	3
4		Professional Elective-III	3-0-0	3
5		Open Elective-II	3-0-0	3
6		Financial Management Costing, Accounting, Balance Sheet & Ratio Analysis/ Professional Ethics, Professional Law &Human Values	2-0-0	2
SESSIONALS				
1	BEC2693	Microwave Engineering Lab.	0-0-3	1.5
2	BEC2695	Simulation Lab-II	0-0-3	1.5
3	BEC2691	Instrumentation Lab.	0-0-3	1.5
NON-CREDIT				
1	BNC06001	Summer Industry Internship/ Training/ Project	0-0-0	0
Total			17-0-9	21.5

COURSE STRUCTURE SEVENTH SEMESTER FOURTHYEAR (THEORY)				
SL NO	COURSE CODE	SUBJECT	CONTACT HRS L-T-P	CR
1	BEC2709	Wave Propagation & Antenna Engineering	3-0-0	3
2	BEC2702	Computer Communication & Networks	3-0-0	3
4		Professional Elective-IV	3-0-0	3
5		Open Elective-III	3-0-0	3
SESSIONALS				
1		Project - I	0-0-6	3
2	BEC2793	Advanced Communication Lab.	0-0-3	1.5
3		Seminar on internship	0-0-3	1.5
TOTAL			12-0-12	18

COURSE STRUCTURE EIGHTH SEMESTER FOURTHYEAR (THEORY)				
SL NO	COURSE CODE	SUBJECT	CONTACT HRS L-T-P	CR
1		Professional Elective-V	3-0-0	3
2		Professional Elective-VI	3-0-0	3
3		Open Elective-IV	3-0-0	3
SESSIONALS				
1		Project II	0-0-12	6
2		Seminar on Project	0-0-2	1
TOTAL			9-0-14	16

Note: Each hour of practical /lab/sessional class = 0.5 credit
The students should undergo Summer Internship or Project in India or Abroad for a minimum period of 8 weeks either in 4th& 6th Semesters together or in one semester at astretch.

List of Professional Elective(Third Year)

Sl. No.	Category	Course Code	Subject Name
1	UPE-I		Control Systems
2		BECPE501	Industrial Electronics
3		BECPE502	Speech and Audio Processing
4		BECPE503	Optoelectronics & Optical aaCommunication
1	UPE-II	BEC2607	Electronic Instrumentation &Measurement
2		BECPE602	Sensors & Transducers
3		BECPE603	Biomedical Instrumentation
4		BECPE604	Intelligent Instrumentation
1	UPE-III	BEC2604	Digital Image Processing
2		BECPE606	Low Power VLSI
3			Optimization Engineering
4			Renewable Energy

List of Professional Elective (Fourth Year)

Sl. No.	Category		Subject Name
1	UPE-IV	BEC2705	Information Theory & Coding
2		BECPE702	Advanced Digital Signal Processing
3		BECPE703	Radar Engineering
4		BEC2705	Satellite Communication
1	UPE-V	BEC2809	Advanced Communication Systems
2		BECPE802	Antenna Analysis & Synthesis
3		BEC2809	Advanced Antenna Technology
4		BECPE804	Smart Antenna
1	UPE-VI		Computer Organization & System Architecture
2		BECPE805	Embedded System
3		BECPE806	IC for Broadband Communication
4		BECPE807	DSP Architecture

List of Open Electives

Sl. No.		Subject Name
1	BECOE501	Microprocessors
2	BECOE502	VLSI Engineering
3	BECOE601	MEMS
4	BECOE701	Image Processing
5	BECOE702	Digital Voice & Picture Communication
6	BECOE801	Audio & Video Systems

FIRST SEMESTER

B. Tech.: Mathematics-I (Calculus and Linear Algebra) (BMA2101) [3-1-0]

Module 1: Calculus (8 Hours)

Rolle's theorem, Mean value theorems (statements only) and applications. Introduction to improper integrals. Beta and Gamma functions and their properties.

Module 2: Calculus (8 Hours)

Convergence of sequence and series, tests of convergence. Fourier series, arbitrary period, even and odd function, half range series.

Module3: Calculus (8 Hours*)*

Limit, continuity and partial derivatives (two variables), maxima and minima. Vector and scalar point functions and fields, gradient of a scalar field, directional derivative, divergence of a vector field, curl of a vector field and applications

Module 4: Linear Algebra (8 Hours)

Linear systems of equations, Gauss elimination, linear independence, rank of a matrix, Gauss-Jordan elimination. Vector Space; basis and dimension'

Module 5: Linear Algebra (8 Hours)

Eigenvalues, eigenvectors, some applications of eigenvalue problems, symmetric, skew-symmetric and orthogonal matrices, diagonalization, quadratic forms, complex matrices and forms.

Text Book:

1) Erwin Kreyszig, Advanced Engineering Mathematics (9th Edition), Wiley India Pvt. Ltd
2) S.C. Malik and S. Arora, Mathematical Analysis, New Age International

Reference Books:

1) George B. Thomas, Jr. and Ross L. Finney, Calculus and Analytic Geometry, Addison WesleyPublishing Company
2) B.V. Ramana, Higher Engineering Mathematics, McGraw Hill
3) A. Stroud, Advanced Engineering Mathematics, Industrial Press
4) S.K. Paikray,Text book of Matrix Algebra, Kalyani Publisher

Course Outcomes:

Upon completion of the subject the students will be able to:

CO1	Recognize basic knowledge of differential calculus, improper integral, Beta and Gamma functions which are useful in various fields of engineering
CO2	Analyse periodic phenomenon and describe Fourier series expansion of periodic function
CO3	Demonstrate functions of several variables that is essential in most of the branches of engineering
CO4	Apply Gauss elimination method and rank of a matrix in solving linear equations
CO5	Implement knowledge of eigenvalues and eigenvectors in a comprehensive manner

Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO 7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	3	-	-	-	2	3			
CO2	3	3	2	2	2	3	3	-	-	-	2	3			
CO3	3	3	2	2	2	3	3	-	-	-	2	3			
CO4	2	3	2	2	2	2	3	-	-	-	2	3			
CO5	3	2	-	-	-	3	3	-	-	-	-	2			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Course	3	3	2	2	2	3	3	-	-	-	2	3

Subject: Chemistry (BCH2101) Credits: 4 [3-1-0]

Module–I (8 Hours)

Schrodinger Wave equations (not to be derived), Application to particle in ID box.
Molecular rotational (microwave) spectroscopy: Basic principle and application to diatomic molecules, selection rules.
Molecular vibrational (IR) spectroscopy: Basic principle, types of vibrations and vibrational frequency, application to Harmonic and anharmonic oscillators, selection rules, modes of vibration.
Electronic (UV-Visible) spectroscopy: Basis principle, types of electronic transitions, The Franck - Condon principle, and Jablonski diagram.

Module – II (8 Hours)
Thermodynamics of Chemical Processes:

Concept of Entropy and free energy, Chemical Potential, Equilibrium Conditions.

Phase equilibria:

Phase, Components, Degree of Freedom, Phase Rule Equation.

Phase Diagrams: One Component Systems – Water and Sulphur, Basic idea of (a) Peritectic system, (b) Eutectoid system, (c) Binary phase diagrams of Pb-Ag & Fe-C system.

Module–III (8 Hours)

Electrochemistry:

Electrode Potentials and its Relevance to Oxidation and Reduction, Types of electrodes, Galvanic cell, Measurement of EMF and application of EMF measurements, Types of reference electrodes (Hydrogen, Glass, Quinhydrone Electrodes,) Determination of pH, Electrochemical energy systems its types (Dry Cells, lead acid cell and Fuel Cells: Construction, reaction, advantages and applications).

Corrosion: Concept, types of corrosion, dry or chemical and wet or Galvanic/electrochemical Corrosion, Factors affecting corrosion.

Module–IV (8 Hours)

Kinetics of complex Chemical Reactions: Reversible, Consecutive and Parallel Reactions, Steady State Approximation, Chain reaction.

Module-V (8 Hours)

Chemistry of engineering materials:

Nanomaterials: Applications of nanomaterials.

Organometallics: Application of organometallics

Books Recommended:

1) P. W. Atkins, Elements of Physical Chemistry, 4th Edition, Oxford University Press
2) C. N. Banwell and E. M. MacCash, Fundamentals of Molecular Spectroscopy, 5th Edition,
3) P. K. Kar, S. Dash and B. Mishra, B.Tech. Chemistry Vol. I, Kalyani Publications

Course Outcomes:

CO1: Apply the basic concept of classical mechanics and quantum chemistry to real life applications & to understand the basic concept of electromagnetic radiation, spectroscopic techniques and their applications.

CO2: Should perceive the spontaneity/feasibility of a process applying thermodynamics concepts and to keep up with the idea of phase equilibria, phase rule and its application to one and two component system.

CO3: Define the application of electrochemistry to commercial electrochemical cell and corrosion.

CO4: Able to apply the basic concept of kinetics of a reaction to complex reactions.

CO5: To demonstrate the properties and applications of organometallics and nanomaterials.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	-	-	3	-	-	2	2	3
CO2	3	3	2	-	-	-	3	-	-	2	2	3
CO3	3	3	2	-	-	-	3	-	-	2	2	3
CO4	3	3	2	-	-	-	2	-	-	2	2	3
CO4	3	3	2	-	-	-	2	-	-	2	2	3

Program Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	2	-	-	-	3	-	-	2	2	3

BASIC ELECTRONICS (BEC2101)

COURSE OBJECTIVE:

1. To impart the fundamentals on electronic devices and its application to various circuits.

2. To impart the knowledge on Digital fundamentals and its application to circuits.

3. To impart the knowledge on electronic measuring instruments and communication fundamentals.

MODULE	CONTENT	HOURS
MODULE 1	Introduction to Electronics: - Signals, Frequency Spectrum of Signals, Analog and DigitalSignals, Linear Wave Shaping Circuits: - RC LPF, Integrator, RC HPF, Differentiator. Properties of Semiconductors: - Intrinsic, Extrinsic Semiconductors, Current Flow in Semiconductors, Diodes: - p-n junction theory, Current-Voltage characteristics, Analysis of Diode circuits, Rectifiers, Clippers, Clampers, Special diodes- LED, Photo diode, Zener Diode.	**10**
MODULE 2	Bipolar junction Transistor (BJTs):- Device Structure and Operation, Current-Voltage Characteristics, BJT as an Amplifier and as a Switch. Introduction to Power Amplifiers: - A,B and Ctypes. JFET:- Physical Structure, Operation and Characteristics	**10**
MODULE 3	Feedback Amplifiers: - General Feedback Structure, Properties of Negative Feedback, Four Basic Feedback Topologies (block diagram only), Practical feedback circuit. Operational Amplifiers (OP-AMPs): - The Ideal OP-AMP, Inverting Configuration, Non-Inverting Configuration. OP-AMP Applications (Adder, Subtractor, Integrator, Differentiator).	**08**
MODULE 4	Digital Fundamentals:- Binary Numbers, Signed-binary numbers, Decimal-to-Binary & Binary-to-Decimal Conversion, Binary Addition, Subtraction, Multiplication and Division, Hexadecimal Number Systems, Logic Gates, Boolean Algebra, De Morgan's Theorems, Laws of Boolean Algebra, RS Flip Flop	**06**
MODULE 5	Introduction to Electronic Instruments: - CRO: CRT, Waveform Display, Applications of CRO, Electronic Multimeter, Audio Signal Generator: - Block diagram, Front Panel Controls. Principles of Communication: - Fundamentals of AM & FM, Block diagram of Transmitters	**06**
TEXT BOOK	**1.** Microelectronics Circuits, A.S Sedra, K.C. Smith, Oxford UniversityPress. Selected portions from chapters 1 to 3, 5, 8,13. **2.** Electronics Fundamentals and Applications, D Chattopadhyay and P.C. Rakshit, New Age International Publications. Selected portions fromchapters	

	4 to 12, 14, 16 to 18,20,21.
REFERENCE BOOK	1. Integrated Electronics, Millman and Halkias, TMHPublications. 2. Electronic Devices & Circuit Theory, R.L Boylestad and L.Nashelsky, PearsonEducation.

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Implement different types of signals and its application to semiconductor devices and circuits.
CO2	Analyze the concept of different BJTs and its operation.
CO3	Express the concept of the Feedback Amplifiers and Operational Amplifiers.
CO4	Apply fundamentals of different Digital arithmetic operations and Digital circuits.
CO5	Demonstrate basic principles of important Electronic Instruments and Communication systems.

Relationship of Course Outcomes (CO) to Program Outcomes (PO)
1 – Low 2 – Moderate 3 – High

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	-	-	-	-	-	2	3
CO2	3	2	3	3	3	-	-	-	-	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	3	3
CO4	2	2	2	2	2	-	-	-	-	-	3	3
CO5	3	0	3	3	2	-	-	-	-	-	2	2

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	**3**	**2**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**3**

PROGRAMMING FOR PROBLEM SOLVING (BCS2102)

L-T-P: 3-0-0 **Cr.-3**

Module I: **(8 Lectures)**

Introduction to computing- Block architecture of a computer, fundamental units of storage: bit, bytes, nibbles, word size. Introduction to problem solving- Basic concepts of an algorithm, program design methods, flowcharts. Level of programming Languages, structure of C program, Compiling and Executing C program

Module II: **(8 Lectures)**

C Language Fundamentals- Character set, Identifiers, Keywords, Data Types, Constant and Variables, Statements. Input &Output - Input & Output Assignments, Formatted Outputs. Operators and Expressions- Operators, Precedence of operators. Decision Control Structure, Loop Control Structure and Case Control Structure.

Module III: **(8 Lectures)**

Functions: Monolithic vs Modular programs, User defined vs standard functions, formal vs Actual arguments, Functions category, function prototypes, parameter passing, Recursion.Arrays1D Array, 2D Array & Multi-Dimensional Array. Strings- Declaration & Initialization, String Handling Functions.

Module IV: **(8 Lectures)**

Pointer variable and its importance, Pointer Arithmetic, Passing parameters, pointer to pointer, pointer to function. Dynamic Memory Allocation. Structure, Nested Structure, Array of Structures, Pointer to Structure, Structure & Functions, Union, Array of Union Variables, Union inside Structure, Bit Fields. Storage Class.

Module V: **(8 Lectures)**

Preprocessor Directives- Types, Pragma Directives, Conditional Directives. typedef, Enumerated Data Type. Files- Reading data from Files, Reading data from Files, Writing data to Files, Error Handling during File Operations. Advanced Issues in Input & Output – using argc&argv.

Text Books:

1. Programming in ANSI C, E Balaguruswamy
2. Computer Fundamentals &Programming in C: ReemaThareja, Oxford University Press.

Reference Books:

1. Let us C- Y.Kanetkar, BPB Publications.
2. Programming with ANSI and Turbo C- Kamthane, A.N. Pearson Education
3. C How to Program- Deitel and Deitel, Pearson Education.
4. The C Programming Language- Brian W. Kernighan and Dennis M. Ritchie, PrenticeHall.

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

1. grasp the fundamentals of Computer and problem solving.

2. conceptualize fundamentals of C Programming along with control structures.
3. Implement different problems on functions and arrays.
4. Apply pointers structures and unions for problem solving.
5. Gain knowledge of pre-processor directives and file operations.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	-	2	3	-	-	3
CO2	3	3	3	3	2	-	-	2	2	-	-	3
CO3	3	3	3	3	2	-	-	2	2	-	-	3
CO4	3	3	3	3	2	-	-	2	2	-	-	3
CO5	3	3	3	3	2	-	-	2	3	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Course	3	3	3	3	2	-	-	2	2	-	-	3

Basic of Civil Engineering (BCE2102)

Module-II **(8 Lectures)**

Introduction to Civil Engineering – Various disciplines of Civil engineering, Importance of Civil engineering in infrastructure development of the country.

Introduction to types of buildings as per NBC, Selection of site for buildings, Components of a residential building and their functions, Introduction to Industrial buildings and types.

Building Planning – Basic requirements, elements, introduction to various building area terms, computation of plinth area, carpet area.

Module-II **(8 Lectures)**

Surveying – Principle and objectives, Instruments used, Horizontal measurements, Ranging (direct ranging only), Instruments used for ranging, Leveling – Definition, Principles, Instruments, Preparation of level book, problems on leveling, Modern surveying instruments – EDM, Total station, GPS (Brief discussion)

Building Materials – Bricks, properties and specifications, Cement – Types, properties, grades, other types of cement and uses, Cement mortar – Constituents, Preparation, Concrete – PCC and RCC, Grades, Steel – Use of steel in buildings, types.

Module-III **(8 Lectures)**

Building Construction – Foundations, Classification, Bearing Capacity of Soil and related terms (definition only), Masonry Works – classifications, definition of different technical terms, Brick masonry – types, bonds, general principle, Roofs – functional requirements, basic technical terms, roof covering material, Floors – function, types, flooring materials(brief discussion), Plastering and Painting – objectives, types, preparation and procedure of application.

Module-IV **(8 Lectures)**

Basic Infrastructure services – air conditioning & purpose, fire protection & materials, Ventilation, necessity & functional requirements, Lifts, Escalators.

Introduction to planning and design aspects of transportation engineering, Transportation modes, Highway engineering – historical development, highway planning, classification of highway, Railway Engineering – cross section of rail track, basic terminology, geometric design parameter(brief discussion only).

Module-V **(8 Lectures)**

Airport engineering – development, types, definition, characteristics of aircraft, basic terminology, Traffic engineering – traffic characteristics, traffic studies, traffic operations (signals, signs, markings), Urban engineering – classification of urban road.

Irrigation & Water Supply Engineering – Introduction, Types of Irrigation, different types of

hydraulic structures, dam and weirs, types of dam, purpose and functions.

Text Books:

- Basic Civil engineering, Gopi, S., Pearson Publication
- Basic Civil Engineering, Bhavikatti, S. S., New Age.

Reference Books:

- Construction Technology, Chudley, R., Longman Group, England
- Basic Civil and Environmental Engineering, C.P. Kausik, New Age.
- American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application

Course Outcomes:

- Analyze the fundamental aspect of building planning.
- Summarize general aspect of building material and surveying.
- Explain about building constructions.
- Judge transportation modes and planning.
- Describe about Airport & Irrigation Structures.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	3	1	1	-	-	-	-	-	-	-
CO2	3	2	1	1	1	-	-	-	-	-	-	-
CO3	2	1	-	2	3	1	-	-	-	-	-	-
CO4	3	2	1	2	1	3	-	-	-	-	-	-
CO5	3	2	3	2	1	1	-	-	2	2	2	3

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	3	2	2	2	2	2	-	-	-	-	-	-

SESSIONAL

B Tech Chemistry Lab: BCH2191

List of Experiments to be done (Any ten Experiments)

1. Determination of amount of sodium hydroxide and sodium carbonate in a Mixture.
2. Determination of Total hardness of water by EDTA method.
3. Estimation of calcium present in the limestone.
4. Standardization of KMnO4 using sodium oxalate.
5. Determination of ferrous iron in Mohr's salt by potassium permanganate.
6. Determination of Rate constant of acid catalyzed hydrolysis of ester.
7. Determination of dissolved oxygen in a sample of water.
8. Conductometric titration of strong acid and strong base
9. Determination of Viscosity of lubricating oil by red wood Viscometer.
10. Determination of Flash point of given oil by Pensky Marten's Flash Point Apparatus.
11. Determination of available chlorine in bleaching powder.
12. Preparation of acidic and basic buffer solution and measurement of PH using PH meter

Book Recommended:

B. Tech Practical Chemistry- .

Course Outcomes:

CO1: Develop knowledge of concepts and applications of chemistry, important laboratory analytical techniques, and instrumentation.
CO2: Apply fundamental principles for environmental analytical methods.
CO3: Identify suitable analytical techniques for analysing a specific compound in a sample and ensure quality control.
CO4: Implement suitable techniques for sampling and handling of environmental and chemical samples.
CO5: Hands on training on using different laboratory apparatus and equipments including data analysis and conclusions.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	-	2	-	2	-	1	-	2	-
CO2	3	1	2	-	2	-	3	-	1	-	2	-
CO3	3	1	2	-	2	-	2	-	2	-	2	-
CO4	3	1	2	-	2	-	3	-	2	-	2	-
CO5	3	1	2	-	2	-	3	-	2	-	2	-

Program Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1-	PO11	PO12
CO	3	1	2	-	2	-	3	-	2	-	2	-

BASIC ELECTRONICS LAB (BEC2191)

SESSIONAL OBJECTIVE:

1. To provide engineering skills for circuit design on breadboard with electronic components.

2. To impart the knowledge on digital fundamentals and digital circuit design.

3. To analyze various Electronic circuits such as BJT, FET, OP-AMPs, Logic gates etc.

Experiment No.	CONTENT
1	Familiarity with electronic components and devices(Testing of semiconductor diode, Transistor, IC Pins connection) Digital Multimeter should be used.
2	Study and use of CRO to view waveforms and measure its Amplitude and Frequency.
3	Frequency response of LPF and HPF.
4	V-I Characteristics of a Semiconductor Diode. Determining DC and AC resistance.
5	Clipper Circuit.
6	Clamper Circuit.
7	Half Wave and Full Wave Rectifier without Capacitor filter. Record of Waveforms, Measurement of Average and RMS value.
8	V-I (Output) Characteristics of N-P-N/P-N-P Transistor in CE Configuration.
9	OP-AMP: Inverting and Non-Inverting Configuration. Record of Waveforms.
10	Verification of Truth table of Logic gates (AND, OR,NOT, NAND, NOR, EX-OR)
SUPPLEMENTARY BOOK	1. Integrated Electronics, Millman and Halkias, TMHPublications. 2. Electronic Devices & Circuit Theory, R.L Boylestad andL. Nashelsky, PearsonEducation.

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Implement Acquire basic knowledge on electronic devices and components
CO2	Analyze different electronics circuits using semiconductor diodes.
CO3	Analyze and develop the characteristics of BJT and FET Circuits.
CO4	Apply fundamentals Operational amplifier circuits.

CO5	Implement knowledge on basic digital logic gates

Relationship of Course Outcomes (CO) to Program Outcomes (PO) 1 – Low 2 – Moderate 3 – High												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	-	-	-	-	-	3	3
CO2	3	2	2	3	3	-	-	-	-	-	3	3
CO3	3	2	3	3	3	-	-	-	-	-	3	3
CO4	3	3	2	3	3	-	-	-	-	-	3	3
CO5	3	3	3	3	2	-	-	-	-	-	3	3

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	2	3	3	-	-	-	-	-	3	3

PROGRAMMING FOR PROBLEM SOLVING LAB (BCS 2191)

L-T-P: 0-0-3 **Cr.-1.5**

Topics to be covered:

1. Programs using Input – Output functions.
2. Programs on variable declaration, assignments, operators and typecasting.
3. Program on selection & iterative constructs.
4. Programs on functions.
5. Programs on arrays.
6. Programs on string manipulation.
7. Programs on pointers.
8. Programs on structure & union.
9. Programs on file handling.
10. A mini-project to be designed by students using features of C.

Course Outcomes

Upon completion of the subject the students will demonstrate the ability to:

CO1: Implement the basicsof C programming.
CO 2: Exercise conditional and iterative statements to develop programs.
CO 3: Exercise user defined functions to solve real time problems.
CO 4: Demonstrate the concept of pointers to access arrays, strings and functions.
CO 5: Create C programs on file manipulations.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	-	2	2	-	-	3
CO2	3	3	3	3	2	-	-	2	2	-	-	3
CO3	3	3	3	3	2	-	-	2	2	-	-	3
CO4	3	3	3	3	2	-	-	2	2	-	-	3
CO5	3	3	3	3	2	-	-	2	2	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Course	3	3	3	3	2	-	-	2	2	-	-	3

Engineering Graphics & Design (BCE01002)

Course Content

Module-I **(8 Lectures)**

Introduction to Engineering Drawing: Drawing instruments, lines, lettering and dimensioning.

Scales: Plain, Diagonal and Vernier Scales.

Module-II **(8 Lectures)**

Curves: Parabola, Ellipse, Hyperbola, Cycloid, Epicycloid, Hypocycloid and Involute.

Module-III **(8 Lectures)**

Orthographic Projections: Concepts, Orthographic projections of points, Lines, Planes and Solids. Sections of solids; Development of surfaces

Module-IV **(8 Lectures)**

Isometric Projections: Principles, Isometric Scale, Isometric Views, Isometric Views of lines, Planes, Simpleand compound Solids.

Module-V **(8 Lectures)**

Introduction to Auto-Cad:

Curves: Parabola, Ellipse, Hyperbola, Cycloid, Epicycloid, Hypocycloid and Involute

Reference Books:

1 Engineering drawing by N.D. Bhatt and V.M Panchal, Charotar Publishing House, Anand.
Engineering Drawing by Venugopal, New Age publisher.

Course Outcomes:

1. Revise basics of engineering drawings and curves.
2. Use Orthographic projections of Lines, Planes, and Solids.
3. Apply Sectioning of various Solids and their representation.
4. Change Pictorial views to Orthographic Projections
5. Construct Isometric Scale, Isometric Projections and Views.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**3**		**3**							
CO2	**3**	**2**	**2**	**3**	**2**							
CO3	**2**	**1**			**2**							
CO4	**3**	**2**	**2**	**2**	**2**	**3**						
CO5	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	**3**	**2**	2	2	**2**	**2**	**3**	**1**	**2**	**2**	**2**	**2**

SECOND SEMESTER

Mathematics-II (Differential Equations and Complex Variables) (BMA2101) [3-1-0]

Module 1: Differential Equations (8 Lectures)

Exact ODEs, integrating factors, linear ODEs, Bernoulli equation, homogeneous linear odes of second order, homogeneous linear ODEs with constant coefficients, Euler-Cauchy equations, non-homogeneous ODEs, Applications of ODEs to electric circuits

Module 2: Power Series Solution of Differential Equations (8 Lectures)

Series solution of differential equation (excluding Frobenius method), Legendre's equation, Legendre polynomials. Bessel's Equation, properties of Bessel's functions, Bessel Functions of the first and Second Kind. **Module 3: Complex Variables (8 Lectures)**

Complex valued function, differentiation, analytic function, Cauchy-Riemann equations, harmonic and conjugate harmonic functions, exponential function, trigonometric and hyperbolic functions, logarithm, general power

Module 4: Complex Variables (8 Lectures)

Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, power series, radius of convergence, Taylor and Maclaurin series, singularities and zeros, Laurent series, Cauchy residue theorem (statement only) and applications.

Module 5: Elementary Numerical Methods (8 Lectures)

Solution of algebraic and transcendental equations by Newton-Raphson and secant method.

Interpolation: Lagrange's method, divided difference method, Newton's forward and backward method. Numerical Integration: Trapezoidal and Simpson's Rule. Numerical solutions of differential equations: Euler's method and improved Euler's method.

Text Book:

1) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd, 9th edition.

Reference Books:

1) K.A. Stroud, Advanced Engineering Mathematics, Industrial Press
2) Milton Abramowitz and Irene A. Stegun, *Handbook of Mathematical Functions*, National Bureau of Standards, Applied Mathematics Series - 55
3) J. Sinha Roy and S. Padhy, Ordinary and Partial Differential Equation, Kalyani Publisher.
4) B.V. Ramana, Higher Engineering Mathematics, McGraw Hill

Course Outcomes:

Upon completion of the subject the students will be able to:

CO1	Develop adequate knowledge of the effective mathematical tools for the solutions of differential equations that models various physical processes
CO2	Describe power series solution of differential equations
CO3	Demonstrate analytic functions and applications of Cauchy-Riemann equations
CO4	Evaluate integration of complex valued functions, and apply Taylor and Laurent series expansions of functions in various fields of engineering problems
CO5	Compute roots of algebraic and transcendental equations, and also evaluate the integrals by Trapezoidal and Simson's rules

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	3	3	-	-	-	2	3
CO2	3	3	2	2	2	3	3	-	-	-	2	3
CO3	3	3	2	2	2	3	3	-	-	-	2	3
CO4	2	3	2	2	2	2	3	-	-	-	2	3
CO5	3	2	-	-	-	3	3	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Course	3	3	2	2	2	3	3	-	-	-	2	3

ENGLISH FOR BUSINESS COMMUNICATION (BHU2102)

Course Description

The course is designed to give students a comprehensive view of communication, its scope and importance in business, and to build the proficiency needed to succeed in today's technologically enhanced workplace. Effective communication is an integral part of life. This course focuses on improving the LSRW skills, i.e. listening, speaking, reading and writing of the students. Students will learn how to communicate effectively though the prescribed syllabus followed by an intensive practice in the language lab. This integrated approach of theory and language lab sessions will help students to communicate clearly with an impact, by improving their verbal and non-verbal communication style, as well as enhancing their competency in grammar and pronunciation. This course further tries to conversant students with the correct practices and strategies in drafting effective business correspondence.

Syllabus

Module 1: Fundamentals of Communication (6 Hours)

- Process of Communication, Types of Communication (Verbal & Non Verbal)
- Channels of Business Communication
- Barriers to Communication.
- Plain English
- Bias free language
- Cross Cultural Communication

Module 2: Communicative Grammar (6 Hours)

- Time and Tense
- Aspects (Perfective & Progressive)
- Verbs of State and Event
- Passive and Active Voice
- Conditionals

Module 3: Sounds of English (06 Hours)

- The Speech Mechanism and Organs of Speech
- Consonant Sounds of English
- Vowel Sounds of English

- ❖ Stress Pattern: Syllable, Stress and Intonation.
- ❖ Problem sounds for Indian Speakers

Module 4: Business Writing (06 Hours)

- ❖ Paragraph writing
- ❖ Sentence Linker
- ❖ Business Letters
- ❖ Report Writing
- ❖ Proposal writing

Module 5: Professional Writing (06 Hours)

- ❖ Notice, Circular and Memo writing
- ❖ Agenda & Minute writing
- ❖ Writing Cover letter
- ❖ Résumé (CV) Writing

Reference Books

1. Effective Technical Communication by M Ashraf Rizvi (Tata McGraw Hill)
2. Business Communication by Hory Sanker Mukerjee (Oxford University Press)
3. Better English Pronunciations by J. D.O Conner (Cambridge University Press)
4. A Communicative Grammar of English by G.N. Leech and Jan Svartik (OUP)
5. Business communication by Ramachandran, Lakshmi and Krishna (Macmillan)

Course Outcomes

Upon completion of the course the students will demonstrate the ability to:

CO1	Analyse various components of human communication and to identify key elements and principles of organizational communication.
CO2	Apply correct usage of English grammar in writing and speaking.
CO3	Evaluate students' ability to articulate English key sounds as well as its basic rhythm, stress and intonation patterns correctly.
CO4	Compile, plan and structure various forms of business writing in a professional manner.
CO5	Write various business documents appropriate for different business and employment situations.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	1	-	1	2	-	1	3	-	-
CO2	-	-	-	2	-	1	2	-	1	3	-	-
CO3	-	-	-	2	-	2	2	-	2	3	-	-
CO4	-	-	-	2	-	2	2	-	2	3	-	-
CO5	-	-	-	-	-	2	2	-	2	3	-	-

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Course	-	-	-	2	-	2	2	-	2	3	-	-

ENGINEERING PHYSICS (BPH2101)

Module-I PROPERTIES OF MATTEER (8 Lectures)

Ideas of Elastic Constants (Y, K, η and σ), relation between elastic constants, torsion pendulum, determination of η, cantilever at one end.

Module-II OSCILLATION AND WAVES (8 Lectures)

Review of Simple Harmonic Oscillation and application to Compound pendulum, Damped Harmonic Oscillation, Forced Oscillation, Resonance, (Amplitude Resonance, Velocity Resonance, and Sharpness of Resonance).

Module-III OPTICS (8 Lectures)

Concept of Wave and wave equation, Superposition of Many harmonic waves, Interference, Concept of coherent sources (Division of wave front and division of amplitude), Interference in thin parallel film, Newton's ring (Theory, Application, Determination of Wavelength of Light, Refractive index of liquid)

Concept of Diffraction (Huygen's Principle), Types of Diffraction, Fraunhofer Diffraction due to a single slit and diffraction Grating, Determination of Wavelength, Dispersive Power and Resolving Power of a Plane Diffraction Grating, Polarization, Double Refraction, Half wave Plate, Quarter wave Plate.

Module-IV ELECTROMAGNETISM (8 Lectures)

Vector Calculus, Gradient, Divergence, Curl (Mathematical Concept), Gauss' Divergence Theorem and Stoke's Theorem (Statement Only), Derivation of Maxwell's Electromagnetic Equations in Differential form and Integral form, Electromagnetic Wave equations for $\vec{E}$ and $\vec{B}$ in vacuum and in conducting medium, Transverse nature of EM waves.

Module-V QUANTUM MECHANICS AND PHOTONICS (8 Lectures)

Wave particle duality, Matter Wave (de-Broglie Hypothesis), Wave Functions, Observables as Operators, Eigen Functions and Eigen Values, Normalization, Expectation Values, Schrodinger equation (Time Dependent and Time Independent), Particle in a box.

Lasers: Introduction and Characteristics of Lasers, Einstein's Coefficients and Relation between them, Lasing Action (Population Inversion, Three and Four level Pumping Schemes), Different types of Lasers (Ruby lasers, He-Ne Lasers).

Text Book:

1. Principle of Engg. Physics: Md. N. Khan and S. Panigrahi
2. Engg. Physics: H.K. Malik and A.K. Singh

Reference Books:

1. Oscillations and Waves: N. Subramanyam and Brij Lal
2. Optics: A. Ghatak
3. Electrodynamics: D.J. Griffith
4. Concept of Modern Physics: A. Beiser
5. Lasers: Theory and Applications: K. Thyagarajan and A.K. Ghatak

Course Outcomes:

Upon completion of the subject the students will be able to:

CO1	Explain the concepts of Stress, Strain, Elastic Modulus and Elastic Constant, Bending of Beams and identify the importance Elastic properties in Engineering Applications
CO2	Demonstrate simple harmonic Oscillator, Damped Harmonic and Forced Oscillators. Express Quality factor and resonance with applications
CO3	Explain the link between Simple Harmonic Motion and Waves. Understand the principle of superposition, the need of coherent sources, analyze the difference between Interference and Diffraction and their applications. Illustrate the concept of Polarization of light and its applications.
CO4	The basic mathematical concepts related to electromagnetic vector fields, Understand the concepts related to Gauss law, Electric and magnetic Flux, Faraday's law, induced emf, Displacement current, Ampere's Circuital law and Maxwell's equations. Expalin the transverse nature of electromagnetic wave
CO5	Identify and understand the kinds of experimental results which are incompatible with classical physics, Interpret the wave function and apply operators to it to obtain information about a particle's physical properties Solve the Schrodinger equation to obtain wave functions for some basic, physically important types of potential in one dimension Describe the requirements for a system to act as a laser. To explain lasing with need of metastable state and population inversion To explain the drawbacks of three level laser system and its solution in four level laser system.

Course Articulation Matrix

Table	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	POP11	PO12
CO1	3	3	2	2	1	-	-	-	-	2	-	1
CO2	3	3	3	2	1	-	-	-	-	2	-	2
CO3	3	3	3	3	1	-	-	-	-	1	-	2
CO4	3	3	3	2	1	-	-	-	-	1	-	2
CO5	3	3	2	3	2	-	-	-	-	2	-	2

Program Articulation Matrix row for this course

Table	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	POP11	PO12
Course	3	3	3	2	1	-	-	-	-	2	-	2

BASIC ELECTRICAL ENGINEERING (BEE02101)

MODULE-I (8 HOURS)

D.C circuit analysis and network theorems: Concept of network, Active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, source transformation, Kirchoff's Law: loop and nodal methods of analysis, star delta transformation, network theorems: Thevenin's theorem, Norton's theorem, maximum power transfer theorem. Transients, in R-L, R-C and R-L-C circuits with DC Excitation.

MODULE-II (8 HOURS)

Single phase and three phase ac circuit: Sinusoidal, square and triangular waveforms-average and effective value, form the peak factors, concept of phasors, phasors representation of sinusoidally varying voltage and current, analysis of series-parallel RLC circuits. Apparent, active and reactive powers, power factor, power factor improvement, resonance in series and parallel circuits, bandwidth and quality factors, star and delta connections, balanced supply and balanced load, line and phase voltage/current relation, three phase power measurements.

MODULE-III (8 HOURS)

Magnet circuit & principle of electromechanical energy conversion: Analogy between electric and magnetic circuit, magnetic circuits with DC and AC excitation, magnetic leakage, BH curve, hysteresis and eddy current losses, magnetic circuit calculation, mutual coupling. Principles of dc motor & generator, types, emf equation of DC machine, torque equation of motor, Speed control of dc motor. characteristics and applications of DC motors.

MODULE-IV (8 HOURS)

AC MACHINES: Single Phase Transformer: Principle of operation, construction, emf equation, equivalent circuit, power losses, efficiency, Introduction to auto transformers. Three Phase Induction Motor: Type, principle of operation, slip-torque Characteristics, applications. Single Phase Induction Motor: Principle of operation and introduction to methods of starting, applications. Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor, emf equation, voltage regulation, applications.

MODULE-V (7 HOURS)

Measurement Instruments & Introduction to Power System: Types of instruments: construction and working principle of PMMC and MI type voltmeter and ammeters, single phase dynamometer type wattmeter and induction type energy meter, use of shunts and multipliers: general layout of electrical power system and function of its elements, concept of grid, Introduction to power converters.

TEXT BOOKS

[1]. Edward Hughes (revised by Ian McKenzie Smith), "Electrical & Electronics Technology", Pearson Education Limited. Indian Reprint 2002, 10th Edition.
[2]. D.Kulshreshtha, "Basic Electrical Engineering" TMH, 1st Edition.

REFERENCE BOOKS

[1]. C.L. Wadhwa, "Electrical Engineering", New Age International Publishers, 2nd Edition.
[2]. S. Parker Smith, "Problems in Electrical Engineering", Asia Publications, 10th Edition.

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Implement principles of DC network, theorems and transients.
CO2	Analyze the concept of Single phase and three phase AC circuits.
CO3	Express the concept of magnetic circuit and DC machines.
CO4	Apply basic principles of AC machines and their working.
CO5	Demonstrate basic principles of measuring instruments and power system.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	3	2	2	-	-	-	3	3
CO2	3	3	2	3	3	2	3	-	-	-	3	3
CO3	3	3	2	3	3	2	3	-	-	-	3	3
CO4	3	3	2	3	3	2	3	-	-	-	3	3
CO5	3	3	2	1	3	2	3	-	-	-	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Course	3	3	2	3	3	2	3	-	-	-	3	3

ENGINEERING MECHANICS (BME02101)

Course Contents

Module - I (8 Hours)

Concurrent forces on a plane: Composition, resolution and equilibrium of concurrent coplanar forces, method of moment.General case of forces on a plane: Composition and equilibrium of forces in a plane, plane trusses, method of joints and method of sections, plane frame, equilibrium of ideal systems.

Module-II (8 Hours)

Friction: Problems involving dry friction, Ladder, WedgesPrinciple of virtual work.

Module - III (8 Hours)

Parallel forces on a plane: General case of parallel forces, center of parallel forces and center of gravity, centroid of composite plane figure and curves, Theorems of Pappus.

Moments of inertia: Plane figure with respect to an axis in its plane and perpendicular to the plane, Polar moment of inertia, parallel axis theorem

Module – IV (8 Hours)

Rectilinear translation: Kinematics, principle of dynamics, D Alembert's Principle,

Principle of work and energy for a particle and a rigid body in plane motion, Conservation of energy, Principle of impulse and momentum for a particle and a rigid bodies in plane motion, Conservation of momentum, System of rigid bodies, Impact, direct and central impact, coefficient of restitution.

Module – V (8 Hours)

Curvilinear translation: Kinematics, equation of motion, projectile, D Alembert's principle of curvilinear motion. Kinematics of rotation of rigid body.

Text Book:

1. Engineering Mechanics: S Timoshenko & Young; 4th Edition (International edition) McGraw Hill.

Reference Books:

1. Fundamental of Engineering mechanics (2nd Edition): S Rajesekharan& G ShankaraSubramanium; Vikas Pub. House Pvt ltd.
2. Engineering mechanics: K. L. Kumar; Tata MC Graw Hill.

Upon completion of the subject the students will be able to:

CO1	Draw free body diagrams and determine the resultant of forces and/or moments.
CO2	Solve the problems involving dry friction.
CO3	Determine the centroid and second moment of area of sections.
CO4	Apply Newton's laws and conservation laws to elastic collisions and motion of rigid bodies.
CO5	Determine the various parameters in projectile motion.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	3	2	-	-	-	3	1	-	2
CO2	3	3	2	3	3	-	-	-	3	2	-	2
CO3	3	3	2	3	3	-	-	-	3	2	-	2
CO4	3	3	2	3	3	-	-	-	3	2	-	2
CO5	3	3	2	1	3	-	-	-	3	2	-	1

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	3	3	2	3	3	-	-	-	3	2	-	2

PHYSICS LABORATORY (BPH2191)

List of Experiments

1. Determination of acceleration due to gravity by using Bar pendulum
2. Determination of surface tension of water by capillary rise method
3. To draw the characteristics of a bipolar junction transistor
4. To determine the rigidity modulus of the material of a wire by using Barton's apparatus.
5. Determination of wave length of monochromatic light with the help of Newton's ring apparatus.
6. Determination of grating element of a diffraction grating using spectrometer.

Course Outcomes

Upon completion of the subject the students will demonstrate the ability to:

CO1	Express the idea of calculation of acceleration due to gravity at any place using the concept of oscillatory system and simple harmonic motion.
CO2	Demonstrate the working and operational technique to calculate the mechanical properties of fluid and other materials.
CO3	Evaluate the voltage, current, power and characteristics behaviour of the electronic devices.
CO4	Analyze the mechanical properties of any material with the idea of elasticity and its various applications.
CO5	Implement the measurement of different characteristic properties and related calculations of optical devices.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	3	2	3	1	3	3	1	1
CO2	3	3	2	1	3	2	3	3	3	3	1	2
CO3	3	3	2	1	3	2	3	3	3	3	1	2
CO4	3	3	2	1	3	2	3	3	3	3	1	2
CO5	3	3	2	1	3	2	1	3	3	3	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Course	3	3	2	1	3	2	3	3	3	3	1	2

BASIC ELECTRICAL ENGINEERING LABORATORY (BEE2191)

List of Experiments

1. Preliminary: Preparation of symbol chart for various systems & components as per ISS, to study the constructional & operational features for Voltmeter, Ammeter, Wattmeter, Frequency meter, multi-meter and Rheostat, Study of safety rules as per ISS
2. Measurement of the armature & field resistance of D.C. Machine by volt-amp method. & Starting and speed control of a D.C. shunt motor
3. Study of BH Curve
4. Determination of open circuit characteristics (O.C.C) of D.C shunt generator when separately excited at different speeds.
5. Measurement of earth resistance and insulation resistance.
6. Starting of Induction motor and measurement of three phase power & power factor by 2- wattmeter method.
7. Callibration of a single phase Energy Meter by directed loading & Phantom loading.
8. Obtaining the voltage, current, power and power factor of fluorescent lamp.
9. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
10. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform

Course Outcomes

Upon completion of the subject the students will demonstrate the ability to:

CO1	Express the safety rules as per ISS and symbols of different electrical components and the use of various electrical instruments in laboratory.
CO2	Demonstrate the working and operational characteristics of dc motor and dc generator.
CO3	Evaluate the voltage, current, power and power factor of fluorescent lamp.
CO4	Implement the measurement of earth resistance and insulation resistance and demonstrate the internal structure of different machines.
CO5	Analyze the connection and calibration of single phase energy meter, three phase power and power factor by two wattmeter method and basic idea about converters.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	3	2	1	2	3	3	3	3
CO2	3	3	2	3	3	2	2	2	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	3	3	3
CO4	3	3	2	3	3	2	2	2	3	3	3	3
CO5	3	3	2	1	3	2	2	1	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Course	3	3	2	3	3	2	2	2	3	3	3	3

Business Communication and Presentation Skills Lab (BHU2191)

Course Description

Good communication skills are indispensable for the success of any professional. The English language, in particular, has become essential in the lives of young engineers who aspire to build their careers anywhere in the world. In this regard the language laboratory plays an important role in developing the students' basic proficiency in English. Since a large number of engineering students completed their education from vernacular medium schools, they lack the basic English language proficiency which is a detrimental factor during recruitment drives in engineering colleges. In this context the language laboratory is very helpful in practicing and assessing students' speech in different communication environments. It provides them facilities to learn pronunciation, accent, stress and rudimentary communicative English grammar along with various practice sessions like presentations, group discussions, debates, case studies which are the part and parcel of corporate life.

Syllabus (Assignments)

1. Functional English grammar: Practice and exercises
2. Practice of English phonemes
3. Reading comprehension
4. Drafting business correspondence
5. Understanding the importance of body language
6. Oral presentations (Self Introduction, Extempore, Formal Presentation, power point presentations etc.)
7. Group discussion
8. Preparation for appearing an interview
9. Situational conversation practice

Reference Books

1. Effective Technical Communication by M Ashraf Rizvi (Tata McGraw Hill)
2. Business Communication by Hory Sanker Mukerjee (Oxford University Press)

3. Better English Pronunciations by J. D.O Conner (Cambridge University Press)
4. A Communicative Grammar of English by G.N. Leech and Jan Svartik (OUP)
5. Business communication by Ramachandran, Lakshmi and Krishna (Macmillan)

Course Outcomes

Upon completion of the sessional the students will demonstrate the ability to:

CO1	Analyse various components of effective human communication and to apply them during various practice sessions.
CO2	Apply correct usage of English grammar in writing and speaking.
CO3	Articulate English key sounds as well as its basic rhythm, stress and intonation patterns correctly.
CO4	Compile, plan and structure various forms of business writing in a professional manner.
CO5	Confidently face various recruitment drives and qualify them.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	2	-	1	3	-	-
CO2	-	-	-	-	-	3	2	-	1	3	-	-
CO3	-	-	-	-	-	2	2	-	2	3	-	-
CO4	-	-	-	-	-	2	2	-	2	3	-	-
CO5	-	-	-	-	-	2	2	-	2	3	-	-

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Course	-	-	-	-	-	3	2	-	2	3	-	-

WORKSHOP & MANUFACTURING PRACTICES (BME2192)

Course content

1. **Carpentry Section**:

Study of different Hand tools, measuring instruments and equipments used in Carpentry work. Safety precautions.

Preparation of Job:
Wooden rack/bench/chair/stool (any one)

Includes the operations:

Measuring, Marking, Sawing, Planing, Chiseling, Mortesing, Tenoning, making Half-lap joint, Mortese&Tenon joint and Nail joint.

2. **Fitting Section**:

Study of different Hand tools, measuring instruments and equipments used in Fitting work. Safety precautions. Study of Drilling Machine and Grinding Machine.

Preparation of Job:

Paper Wt. / Square or Rectangular joint (male-female joint) (any one)

Includes the operations:

Measuring, Marking, Filing, Sawing, Drilling, Tapping, Dieing and Punching.

3. **Black Smith Section**:

Study of different Hand tools, equipments, Open hearth furnace and Induction furnaces used in Blacksmith work. Different types of heat treatment processes. Safety precautions.

Preparation of Job:

Weeding hook/Hexagonal headed bolt/Chisel (any one)

Includes the operations:

Measuring, Marking, Cutting, Upsetting, drawing down, Bending, Fullering and Quenching.

Course Outcomes:
Upon completion of the subject the students will be able to:

CO1	Acquire knowledge on different types of hand tool, measuring instruments and machine tools are used in Fitting, Carpentry and Smithy work.
CO2	Know about different types of operations and joints performed in different shops i.e. in Fitting and Carpentry.
CO3	Know about the forging temperature of different types of ferrous metals and different types of operation (e.g. upsetting, edging, flattening and bending etc.) carried out on hot metals to prepare jobs.
CO4	Acquire skills for the preparation of different types of jobs Carpentry/fitting/smithy shops by using different types of hand tools and machine tools.
CO5	Understand the importance of safety precaution in different shops.

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	2	2	2	2	1	3	2	2	3
CO2	-	-	1	2	2	2	2	2	3	2	2	2
CO3	-	-	-	1	1	2	1	2	3	1	2	1
CO4	-	-	-	3	3	2	3	1	3	3	2	1
CO5	-	-	-	-	-	-	-	3	2	1	1	1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	-	-	1	2	2	2	2	2	3	2	2	2

THIRD SEMESTER

Mathematics-III (Transforms, Probability and Statistics and Multi variate Analysis) [3-1-0] (BMA2301)

Module 1: Laplace Transforms (10 Lectures)

Laplace transforms, inverse transforms, linearity, shifting, transforms of derivatives and integrals, solution of ODEs, unit step function, Dirac's delta function, differentiation and integration of transforms, convolution, integral equations.

Module 2: Fourier Transforms (8 Lectures)

Basic concept of Fourier integral, Fourier sine and cosine integral, condition of convergence, Fourier transformation, Fourier sine transform, Fourier cosine transform, properties.

Module 3: Probability (6 Lectures)

Random variables, probability distributions, mean and variance, Binomial, Poisson and hyper-geometric distributions, Normal distribution.

Module 4: Statistics (8 Lectures)

Random sampling, point estimation of parameters, maximum likelihood estimation, confidence intervals, testing of hypotheses for mean and variance, correlation and regression.

Module 5: Multi-variate Analysis (8 Lectures)

Line integrals, double integrals, change of order, Green's theorem (statements only), surface integrals, triple integrals, Divergence theorem of Gauss (statements only), Stoke's theorem (statements only) and applications.

Text Book:

Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd, 9th edition

Reference Books:

1) B.V. Ramana, Higher Engineering Mathematics, McGraw Hill
2) K.A. Stroud, Advanced Engineering Mathematics, Industrial Press

Course Outcomes:

Upon completion of the subject the students will be able to:

CO1	Develop adequate knowledge of Laplace and Fourier transforms, and apply this idea to solve differential equations
CO2	Describe unit step function and Dirac's delta function which are useful in engineering problems
CO3	Apply Binomial, Poisson and Normal distributions in probabilistic models
CO4	Demonstrate random sampling and estimation of parameters
CO5	Evaluate multiple integrals and with various applications

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	3	1	-	-	-	1	2
CO2	3	3	2	2	3	3	1	-	-	-	2	3
CO3	3	3	2	2	3	3	1	-	-	-	2	3
CO4	3	3	2	2	3	3	1	-	-	-	2	3
CO5	3	3	2	2	3	2	1	-	-	-	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Course	3	3	2	2	3	3	1	-	-	-	2	3

NETWORK THEORY (BEC2307)

MODULE	CONTENT	HOURS
MODULE 1	ELEMENTARY CIRCUIT ANALYSIS AND NETWORK THEOREMS: Series and parallel combination of elements, Kirchhoff's laws, Node and Mesh Analysis, Application of Network Theorems in DC & AC Circuits (Thevenin's, Norton's, Superposition, Maximum PowerTransfer)	4
MODULE 2	RESONANCE: Series Resonance, Parallel Resonance, Selectivity. Q-factor TRANSIENT RESPONSE OF PASSIVE CIRCUITS:Transient response of series R-L, R-C & R-L-C circuit with DC and sinusoidal excitation. LAPLACE TRANSFORMATION AND ITS APPLICATION: Laplace transformation of a derivative and an Integral function, Initial and final value theorem, Convolution. WAVEFORM SYNTHESIS: The Unit step, Ramp and Impulse Function, Waveform Synthesis.	8
MODULE 3	TWO PORT NETWORK ANALYSIS: Network Elements, {Z, Y, Hybrid & ABCD}-Parameters, Condition of Reciprocity and Symmetry, Inter relationship between Parameters of two port network, different types of Interconnections of two port networks, Image Impedances, Equivalent T- & π- sectionrepresentation. INTRODUCTION TO GRAPH THEORY: Relation between twig and link. Properties of tree in graph, Formation of Incidence Matrix, Tie-Set matrix, Cut-Setmatrix	10
MODULE 4	PROPERTIES OF NETWORK FUNCTIONS: Driving and Transfer Impedance & admittance, Voltage and Current Transfer Ratio, Concept of Poles and Zeros in network functions, Restriction on location of poles & zeros, Routh-Hurwitz Criterion of Stability, Time domain behavior from pole-zero plot.	8
MODULE 5	SYNTHESIS OF PASSIVE NETWORKS: Hurwitz Polynomials, properties of Hurwitz polynomials, procedure of testing for Hurwitz characteristics, Properties of positive real functions, procedure for testing of PR function, Network Synthesis, Reactive Networks, Pole-Zero interpretation in LC networks, LC network synthesis, *Foster's* canonic forms, *Cauer*Canonic forms, Identification of *Foster &Cauer*form of RL/RC networks, *Foster &Cauer*form synthesis of Lossy networks.	10
TEXT BOOK	1. Network Analysis, by M.E. Van Valkenburg, 3rd Edition,PHI 2.Citcuit Theory, Analysis & Synthesis By A. Chakrabarti, Dhanpat Rai &Co.	

REFERENCE BOOK	1. Network Analysis and Synthesis, By Franklin F. Kuo,Wiley 2. Network Theory: Analysis And Synthesis 1st Edition By SmarajitGhosh.

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze the electrical networks usingTheorems
CO2	Analyze the resonating circuit and solve the transient behavior of passive circuits.
CO3	Implement the reciprocal and symmetrical circuits using circuit parameters and to apply the graph theory.
CO4	Apply stability of a network and to understand the location of poles and zeros.
CO5	Implement the reactive ladder networks of Foster and Cauer canonicforms.

Relationship of Course Outcomes (CO) to Program Outcomes (PO)
1 – Low 2 – Moderate 3 – High

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	2	2	2	-	2	2
CO2	3	3	3	3	3	3	2	2	3	-	3	3
CO3	3	3	3	3	2	3	2	2	3	-	3	3
CO4	3	3	3	2	2	3	2	2	3	-	3	3
CO5	3	3	3	3	2	2	2	2	2	-	2	2

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**-**	**3**	**3**

ANALOG ELECTRONIC CIRCUIT(BEC 2305)

MODULE	CONTENT	HOURS
MODULE 1	DC Analysis, Load lines, Operating Point, Fixed bias ,Emitter bias, Voltage-divider bias. DC bias with voltage feedback, Bias stabilization, Design of bias. Amplification in AC domain, BJT transistor modelling , The r_e transistor model, Low frequency small signal analysis of CE(fixed bias, voltage divider bias, emitter bias), Effects of R_S and R_L, Analysis of transistor amplifier using Hybrid equivalent model, Graphical determination of h-parameters, Approximate conversion formulae of variousconfigurations.	10
MODULE 2	DC Biasing of MOSFETs: Biasing by fixing V_{GS}, Biasing by fixing V_G and connecting a resistance in source, Biasing using drain to gate feedback resistor Small Signal operation and models: DC bias point, signal current in Drain terminal, Voltage gain, Separating DC analysis and signal analysis, Small signal equivalent models, Transconductance g_m Single-stage MOSFET Amplifiers: Common-Source (CS) amplifiers, Common-Source amplifiers with a source resistance, Common-Gate (CG) amplifiers, Common-Drain (CD) or Source follower amplifiers.	10
MODULE 3	BJT Frequency Response: Decibel ,General frequency considerations, normalization process, Low frequency analysis of R-C combination in single stage BJT amplifier- Bode Plot, Miller Effect Capacitance, HighfrequencyresponseofBJTAmplifier,SquareWavetestingof amplifiers.	6
MODULE 4	Operational Amplifiers: OP-AMP Specifications, DC offset parameters, frequency parameters, Gain-bandwidth, Slew rate, Differential and Common mode operation, OP-AMP Applications: Constant gain multiplier, Voltage Buffer, Controlled sources. Compound Configurations: Cascade, Cascode and Darlington connections, Current Source Circuits, Current Mirror Circuit, Differential amplifier Circuit.	7
MODULE 5	Positive feedback circuit as Oscillator, Barkhausen's criteria for oscillation, Crystal Oscillator, Colpitt and Hartley Oscillator, R-C phase shift oscillator and Wien Bridge Oscillator. Classification of Power Amplifiers, Power dissipation and power conversion efficiency of Class A, Class B amplifiers, Push-pull amplifier Voltage Regulators: Transistor series voltage regulator, OP-AMP voltage regulators.	7
TEXT BOOKS	1. Microelectronic Circuits – Sedra& Smith, International StudentEdition 2. Electronic Devices and Circuit Theory – Robert L.BoylestadandLowisNashelsky, PearsonPublication	
REFERENCE BOOKS	1. Millman's Integrated Electronics –Jacob Millman and Christos Halkias, Chetan D Parikh, McgrawHill 2. Electronic Devices – Floyd, PearsonEducation	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze basic knowledge of BJT biasing and stabilization and develop the ability to analyse transistor r_e and hybrid models.
CO2	Analyze the characteristics and analysis of different configurations of single stage MOSFET amplifiers.
CO3	Implement the amplifier circuits using BJT and study the low and high frequency response of BJT amplifiers.
CO4	Apply operational amplifier's specifications and parameters and its various applications. Student will learn about various compound configurations.
CO5	Implement various power amplifiers and voltage regulators and they will have thorough knowledge of various oscillator circuits.

Relationship of Course Outcomes (CO) to Program Outcomes (PO) **1 – Low** **2 – Moderate** **3 – High**												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	2	-	-	-	3	2
CO2	3	3	3	3	2	2	2	-	-	-	3	3
CO3	3	3	3	3	3	2	2	-	-	-	3	3
CO4	3	3	3	2	2	2	2	-	-	-	3	3
CO5	3	3	3	3	3	2	2	-	-	-	3	2

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**3**	**3**

SIGNALS AND SYSTEMS (BEC2306)

MODULE	CONTENT	HOURS
MODULE 1	Introduction to Signals and Systems: Transformations of independent variables, singularity functions and elementary signals. Classification of signals: Continuous , discrete time signals and discrete amplitude signals, Energy and power signals, odd and even signals ,periodic and aperiodic signals etc.	5
MODULE 2	Basic system properties : Linearity: additive and homogeneity, time/shift invariant, causality, stability. Continuous time LTI systems, properties of convolution integral, discrete time LTI systems, convolution sum, properties of convolution sum, Relation between LTI systems properties and impulse response , correlation of signals.	10
MODULE 3	System representation through differential and difference equations. Fourier series representation: ContinioustimeFourier series (CTFS),Dirichlet conditions, properties of CTFS, discrete time Fourier series (DTFS) , properties of DTFS .	10
MODULE 4	The Continious time fourier transform, fourier transform representation of aperiodic signals, Properties of fourier transform, convergence of fourier transform. Fourier transform representation of periodic signals. Signal transmission through LTI systems, Ideal and practical filters . Energy spectral density ,power spectral density. PSD of periodic signals.	10
MODULE 5	The discrete time fourier transform(DTFT) and the discrete time fourier transform for aperiodic discrete time signals, properties of DTFT, fourier transform of periodic signals. Ideal and practical filters . Energy spectral density ,power spectral density.	5
TEXT BOOK	1. Signal and systems,Tarunkumar Rawat.,1st edition ,2015,Oxford universitypress. 2. A.V.OppenheimandSchafer.	
REFERENCE BOOK	1.Douglask.Lindner. 2.B.P.Lathi. 3. Symon haykin .	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze different types of signals.
CO2	Implement and represent continuous and discrete time systems.
CO3	Implement the systems in time and frequency domain using Fourier series.
CO4	Analyze the CTFT for different signals.
CO5	Implement DTFT of different signals.

Relationship of Course Outcomes (CO) to Program Outcomes (PO) 1 – Low 2 – Moderate 3 – High												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	2	-	-	-	3	3
CO2	3	3	3	3	2	-	3	-	-	-	3	3
CO3	3	3	3	3	2	-	3	-	-	-	3	3
CO4	3	3	3	3	3	-	3	-	-	-	3	3
CO5	3	3	2	3	2	-	3	-	-	-	3	3

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	3	2	-	3	-	-	-	3	3

Economics for Engineers (3-0-0) (BHU2303)

Course Objectives:

- To understand the basic economic principle as a consumer in an economy
- To be able to know the utility measurement in the presence of risk and uncertainty
- To prepare the Engineering students to learn about the production process and analyse the cost/revenue data.
- To provide the foundation for engineers to make good decisions in business environment and learn about the market mechanism.
- To be able to make decision on project alternatives and justify projects on an economic basis

Syllabus:

Module-1: (8 Lectures)

Theory of Demand: Demand and Utility, Demand function and the factors determining demand, Law of Demand, Reasons for downward sloping demand curve, Exceptions to the law of demand. The market forces of Supply and Demand, Elasticity of demand and its application, Utility analysis: cardinal and ordinal measurability of utility, Assumptions of cardinal utility analysis, law of diminishing marginal utility, Consumer's equilibrium: Principle of equi-marginal utility

Module-2: (8 Lectures)

Indifference curve analysis of demand: Concepts, properties, Equilibrium of the consumer, Price Consumption Curve (PCC) and Income Consumption Curve, Decomposition of price effect into income effect and substitution effect, Revealed preference hypothesis, Individual choice under Risk and Uncertainty: St. Petersburg paradox and Bernoulli's hypothesis, Neumann-Morgenstern method of constructing utility index, Friedman-Savage hypothesis, Markowitz hypothesis

Module-3 (8 Lectures)

Production function: short run analysis, Total product, Average product and Marginal product, output elasticity of input, law of variable proportion, Long run production function: Isoquants and concepts of returns to scale, Optimum factor combinations, Homogeneous Production Function, Cobb–Douglas production function, CES Production function, Cost Analysis: Concepts, Accounting cost, Fixed and variable cost, opportunity cost, Short run and long run cost curves, Relationships between average cost and marginal cost

Module-4 (8 Lectures)

Market and its classifications, Perfect competition: Characteristics, Short run and long run equilibrium of firm under perfect competition. Monopoly market: Price and output determination. Modern theories of firms: Baumol's theory of sales revenue maximisation, Bain's limit pricing model

Module-5 (8 Lectures)

Time value of money: use of cash flow diagram, Annual economic worth, present worth, future worth, Internal Rate of Return (IRR), Net Present Value (NPV), Payback period method, Analysis of public projects: Cost-Benefit analysis, cost effectiveness

Reference Books:

1. Koutsoyiannis, A. (1979). Modern Microeconomics. The Macmillan Press Ltd., London
2. Varian, H. R. (1992). Introduction to Micro Economic Analysis, Norton and company, New York
3. Salvatore, D. (2008). Microeconomics: theory and applications. Oxford University Press

4. Pindyck, R. S., D. N. Rubinfeld and P. L. Meheta (2009). Microeconomics, Pearson India, New Delhi
5. Panneerselvam, R. (2007). Engineering Economics, Prentice-Hall of India, New Delhi
6. Henderson, J. M. and R. E. Quant (2011). Microeconomic Theory: A Mathematical Approach, Indian Higher Education, New Delhi
7. Intriligator, M. D., R. G. Bodkin and C. Hsiao(1995). Econometric Models, Techniques, and Applications, Pearson India, New Delhi

Course Outcomes:

Upon completion of the subject the student will be able to :

CO1	Utilise economics principles in consumption process
CO2	Describe the utility measurement and measure the utility associated with risk
CO3	Efficient use of resources in production and take decision regarding optimum output
CO4	Describe market mechanism and analyse product market to take proper decisions
CO5	Implement economic principles in company related decision making

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	-	-	-	3	3
CO2	-	-	-	-	-	3	2	2	-	-	2	1
CO3	-	-	-	-	-	3	3	-	-	-	3	-
CO4	-	-	-	-	-	2	2	3	1	-	3	-
CO5	-	-	-	-	-	1	2	3	2	-	3	1

Program Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	-	-	-	-	-	2	2	3	2	-	3	2

SESSIONAL

ANALOG ELECTRONICS CIRCUIT LAB (BEC2391)

Experiment No.	CONTENT
1	Study of biasing circuits of BJT.
2	Study of biasing circuits of JFET.
3	Measurement of pinch off voltage and plot transfer characteristics and drain characteristics of JFET.
4	Plotting of gain frequency response of RC coupled amplifier.
5	Study of Class A,B power amplifier.
6	Study of integrator and differentiator circuits using OPAMP.
7	Study and calculation of phase-shift of RC phase shift oscillator.
8	Calculation of rise time tilt and low cut off frequency by square wave testing of amplifier.
9	Study of biasing circuits of MOSFET.
10	Plot transfer characteristics and drain characteristics of MOSFET.

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Implement the various bias circuits of BJT, JFET and MOSFET. Have knowledge about the characteristics of JFET and MOSFET.
CO2	Analyzethe operation of various power amplifier circuits.
CO3	Implement the knowledge on the frequency response of RC coupled amplifier.
CO4	Analyze RC phase shift oscillator and square wave testing of amplifier.
CO5	Demonstrate the operation of integrator and differentiator circuits using OPAMP.

Relationship of Course Outcomes (CO) to Program Outcomes (PO) **1 – Low** **2 – Moderate** **3 – High**												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	-	2	2	-	-	-	-	3
CO2	3	3	3	3	2	2	2	-	-	-	-	3
CO3	3	3	3	3	2	2	3	-	-	-	-	3
CO4	3	3	3	3	3	2	2	-	-	-	-	3
CO5	3	3	2	3	3	2	3	-	-	-	-	3

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**3**

NETWORK THEORY LAB (BEC2396)

Experiment No.	CONTENT
1	To verify the maximum power transfer theorem for different internal resistance.
2	Study of Norton's, Thevenin's, superposition Theorem.
3	Study of transient response of series and parallel RL & RC circuit.
4	Study of transient response of series and parallel RLC circuit.
5	Determination of Impedance (Z), Admittance(Y) & Hybrid parameters of two port network
6	Generation of Periodic, Exponential, Sinusoidal, Damped sinusoidal, Step, Impulse, Ramp signals in analog form.
7	Determination of Impedance (Z) & Admittance (Y) parameters of two port networks using circuit maker.
8	Determination of driving point and transfer functions of a two port ladder network and verify with theoretical values.
9	Measurement of Z- parameter of T- and π- networks.
10	Determination of Laplace transforms and inverse Laplace transformation using MATLAB

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Evaluate the application of network theorems.
CO2	Analyzethe response of passive circuits.
CO3	Implement the measurement of earth resistance and insulation resistance and demonstrate the internal structure of different machines.
CO4	Demonstrate the ladder network.
CO5	Demonstrate different waveforms in analog forms.

Relationship of Course Outcomes (CO) to Program Outcomes (PO)

1 – Low 2 – Moderate 3 – High

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	-	2	2	2	3	-	-	3
CO2	3	3	3	2	2	2	3	2	2	-	-	3
CO3	3	3	3	2	2	2	2	2	3	-	-	3
CO4	3	3	3	2	3	2	3	2	3	-	-	3
CO5	3	3	3	2	-	2	3	2	2	-	-	3

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	2	3	2	3	2	3	-	-	3

SIGNALS & SYSTEMS LAB-1 (0-0-3) (BEC2395)

Experiment No.	CONTENT
1	Study of various signals.
2	Study of various classifications of signals.
3	Design and study of LTI systems.
4	Design and study of CTFS systems.
5	Design and study of DTFS systems.
6	Computation of PSD of periodic signals.
7	Computation of energy spectral density signals.

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze various signals.
CO2	Evaluate modifications of various signals.
CO3	Analyze the performance of LTIsystems.
CO4	Demonstrate CTFS & DTFS systems.
CO5	Express theconclusions after computing PSD.

Relationship of Course Outcomes (CO) to Program Outcomes (PO) **1 – Low** **2 – Moderate** **3 – High**												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	2	-	-	-	-	3
CO2	3	3	3	2	2	-	3	-	-	-	-	3
CO3	3	3	3	2	2	-	2	-	-	-	-	3
CO4	3	3	3	2	3	-	3	-	-	-	-	3
CO5	3	3	3	2	2	-	3	-	-	-	-	3

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	**3**	**3**	**3**	**2**	**3**		**3**					**3**

SIMULATION LAB-1 (0-0-3) (BEC2393)

Experiment No.	CONTENT
1	Study and design of low pass, high pass & band pass filters.
2	Design of half wave and full wave rectifiers with and without capacitor filter.
3	Design and study of zener diode as a voltage regulator.
4	Design and study of common emitter- BJT fixed bias configuration for suitable operating point in an amplifier application.
5	Design and study of BJT fixed bias common emitter amplifier.
6	Design and study of RC phase shift oscillator
7	Design and study of amplitude modulation using Analog Multiplier IC-AD633JN.
8	Design and study of amplitude demodulation using Analog Multiplier IC-AD633JN.
9	Design and verification a of comparator circuit using OPAMP.
10	Design and test different application circuits using 555 Timer IC.
SUPPLEMENTARY BOOK	1. Microelectronics Circuits, A.S Sedra, K.C. Smith, Oxford UniversityPress. 2. Integrated Electronics, Millman and Halkias, TMHPublications

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Evaluatethe desired circuit specifications to choose the circuit design steps.
CO2	Analyzemodifications in the design as per hardware and specification constraints.
CO3	Analyze the performance of circuits and tweak suitable changes to suit the specification.
CO4	Evaluate the observed performance with design parameters.
CO5	Demonstrate conclusions after performing a design experiment.

Relationship of Course Outcomes (CO) to Program Outcomes (PO) **1 – Low** **2 – Moderate** **3 – High**												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	-	2	-	-	-	-	3
CO2	3	3	3	2	2	-	3	-	-	-	-	2
CO3	3	2	3	3	2	-	2	-	-	-	-	2
CO4	3	2	3	3	3	-	3	--	--	--	--	3
CO5	3	2	3	2	3	-	3	-	-	-	-	2

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	3	2	3	3	3	-	3	3	-	-	-	2

FOURTH SEMESTER

DIGITAL SYSTEM DESIGN (BEC2409)

MODULE	CONTENT	HOURS
MODULE 1	Logic Simplification: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 5 variables, Binary codes, Code Conversion, Binary addition and subtraction using 2's and 1's complements.	6
MODULE 2	Combinational Logic Design: MSI devices like Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Binary multiplier, magnitude comparator, Multiplexers, Encoder, Decoder,	8
MODULE 3	Sequential Logic Design: Building blocks like S-R, D, T, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Analysis of clocked sequential circuits, Finite state machines, Design of synchronousFSM,	10
MODULE 4	Logic Families and SemiconductorMemories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements: RAM, ROM, Memory Decoding, Concept of Programmable logic devices like FPGA. Logic implementation using ProgrammableDevices.	10
MODULE 5	VLSI Design flow: Design entry: Schematic, FSM & HDL, different modelling styles in VHDL, Data types and objects, Dataflow, Behavioural and Structural Modelling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.	6
TEXT BOOK	1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009. 2. Digital Design, 4th edition by M. Morris Mano, M. D. Ciletti, Pearson Education. 3. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition,2002.	
REFERENCE BOOK	1. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition,2006. 2. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill,1989 3. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyse fundamentals of digital electronics logiccircuits.
CO2	Analyzemodular combinational circuits with MUX/DEMUX, Decoder,Encodes.
CO3	Demonstratethe synchronous sequential logic circuits.
CO4	Evaluate the memory decoding and implementation of function using ProgrammableLogicDevices(PLDs)..
CO5	ImplementHDL & appropriate EDA tools for digital logic design and simulation.

Relationship of Course Outcomes (CO) to Program Outcomes (PO) **1 – Low** **2 – Moderate** **3 – High**												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	2	2	2	2	3	2
CO2	3	3	3	3	3	2	3	2	3	3	3	3
CO3	3	3	3	3	3	2	3	2	3	3	3	2
CO4	3	3	3	2	2	2	3	2	3	3	3	3
CO5	3	3	3	3	3	2	2	2	2	2	3	2

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**

PRINCIPLES OF ANALOG & DIGITAL COMMUNICATION (BEC2406)

MODULE	CONTENT	HOURS
MODULE 1	Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.	8
MODULE 2	Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation.	8
MODULE 3	Sampling Theorem, Low Pass Signal, Band Pass Signal, Signal Reconstruction, Practical Difficulties, The Treachery of Aliasing, The Anti-aliasing Filter, Application of Sampling Theorem, PAM, PWM and PPM Signal Generation and Detection.	8
MODULE 4	Pulse Code Modulation: Quantization of Signals, Uniform and Non-Uniform Quantization, The Compander, The encoder, Transmission Bandwidth and output SNR, Digital multiplexer, Synchronizing and Signaling, Differential PCM, Delta Modulation, Adaptive Delta Modulation, Output SNR, Comparison with PCM. Noise in PCM and DM: Calculation of Quantization Noise Power, Output Signal Power, and the Thermal Noise Power, Output SNR of PCM using different modulation techniques. Output SNR of DM.	8
MODULE 5	Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion. Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.	8
TEXT BOOK	1. Haykin S., "Communications Systems", John Wiley and Sons,2001. 2. Modern Digital and Analogue Communication Systems by B.P.Lathi, 3rd Edition, Oxford UniversityPress. 3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill,2001.	
REFERENCE BOOK	1. Proakis J. G. and Salehi M., "Communication SystemsEngineering", Pearson Education,2002 2. Wozencraft J. M. and Jacobs I. M., ``Principles ofCommunicationEngineering",John Wiley,1965. 3. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers,2004.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Understand basic elements of a communication systems.
CO2	Analyzeof baseband signals in time domain and in the frequency domain.
CO3	Demonstrate understanding of various analog and digital modulation and demodulation techniques.
CO4	Analyze the performance of modulation and demodulation techniques in various transmission environments.
CO5	Demonstrate the importance of synchronization in communication systems.

Relationship of Course Outcomes (CO) to Program Outcomes (PO) **1 – Low** **2 – Moderate** **3 – High**												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	2	2	2	2	3	2
CO2	3	3	2	3	3	2	3	2	3	3	3	3
CO3	3	3	3	3	3	2	3	2	3	3	3	2
CO4	3	3	2	1	2	2	3	2	2	3	3	3
CO5	3	3	2	2	3	2	2	2	2	2	3	2

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**2**

ADVANCED ELECTRONICS CIRCUIT (BEC2407)

MODULE	CONTENT	HOURS
MODULE 1	Review of Selected Topics in Electronic Circuits, Active Filters: First & Second order low pass/high pass, band pass, band reject, and all pass filters. Universal active filter design, Comparators, Sawtooth wave generator using OP Amps, Waveform Conversion, Instrumentation Amplifier.	8
MODULE 2	Wideband amplifiers: Frequency response, Transient response of transistor stage, shunt compensation of a transistor stage in cascade, Rise time of cascaded compensated stages, low frequency compensation. Tuned Amplifiers: Single tuned, Double tuned, Staggered tuned.	8
MODULE 3	BistableMultivibrator: Stable States of a binary, Fixed Biased and Self-biased Transistor binary, Commutating Capacitors, Symmetrical and Unsymmetrical triggering, Direct connected binary, Schmitt trigger Circuit, Emitter coupled Binary. The MonostableMultivibrator: Collector coupled Monostable Multi, Waveforms, Emitter-coupled Monostable Multi, triggering of Monostable Multi. Astable-Multivibrator: Emitter Coupled, Collector Coupled,Waveforms.	8
MODULE 4	Negative resistance devices and Negative Resistance Switching Circuits: Tunnel diode, UJT operation and characteristics, Application of UJT to generate Sawtooth waveform, Tunnel diode monostable, astable, bistable and comparator circuits.	8
MODULE 5	Analysis of Voltage time base generator, Current time base generator, IC 555 Timer Circuit and Applications, Voltage Controlled Oscillator, Phase Locked Loop.	8
TEXT BOOK	1. Pulse, Digital and switching Waveforms – Jacob Millman, Herbert Taub, M. Prakash Rao, 2nd Ed, The McGraw-Hill Companies (Selected portions from Chapters 4, 5, 10, 11, 12, 13, 14 and15) 2. Electronic Principles- A.Malvino, D.Bates, 7thed, The McGraw-Hill Companies. (Selected Portions from Chapters 21, 22, 23 for Module 1 and 4 only) 3. OP-Amps and Linear Integrated Circuits-RamakantA.Gayakwad (PHI LearningPvt.Ltd.)	
REFERENCE BOOK	1. Pulse and Digital Circuits by A.Anand Kumar, PHI Learning Pvt.Ltd. 2. Pulse, Digital and switching Waveforms – Jacob Millman and HerbertTaub	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Understand different filter application in circuit design.
CO2	Express to improvement of frequency response of the amplifiers.

CO3	Demonstrate the integration of multivibrators in the circuit design.
CO4	Analyze the generation of time base signal for the multivibrators.
CO5	Evaluate the development of real time applications.

Relationship of Course Outcomes (CO) to Program Outcomes (PO) **1 – Low 2 – Moderate 3 – High**												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	2	2	2	2	3	2
CO2	3	3	3	3	3	2	3	2	3	3	3	3
CO3	3	3	3	3	3	2	3	2	3	3	3	2
CO4	3	3	3	2	2	2	3	2	3	3	3	3
CO5	3	3	3	3	3	2	2	2	2	2	3	2

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**

ELECTROMAGNETIC FIELD THEORY & TRANSMISSION LINES (BEC2408)

MODULE	CONTENT	HOURS
MODULE 1	Vector calculus – orthogonal Coordinate System, Transformations of coordinate systems; Gradient, Divergence, Curl – their physical interpretations; Laplacian operator, Divergence Theorem, Stokes Theorem. Useful vector identities.	5
MODULE 2	Coulomb's law, electric field intensity, Field due to a line charge, Sheet charge and continuous volume charge distribution; Gauss' law, Application of Gauss's law, flux density, Potential and Potential gradient, Divergence theorem, Current Densities, Conductors, Poisson's & Laplace's equations. Uniqueness theorem, Biot-Savart's law, Ampere's law, Vector magnetic Potential.	7
MODULE 3	Faraday's law, Maxwell's equations, Equation of continuity, Concept of Displacement Current. Electromagnetic Boundary Conditions, Poynting's Theorem, Time-harmonic EM fields, Helmholtz wave equation. Plane wave solution. Plane Wave Propagation in lossless and lossy dielectric medium and conducting medium. Plane wave in good conductor, Surface resistance, depth of penetration. Polarization of EM wave- Linear, Circular and Elliptical polarization. Reflection and Transmission for normal incidence.	12
MODULE 4	High Frequency Transmission line: The Lumped-Element Circuit model for a Transmission line. Wave propagation. The lossless line. Field Analysis of Co-ax Transmission Lines. R, L, C, G parameters of Co-axial & Two wire Transmission lines, Terminated lossless transmission line, Low loss line, The Smith Chart. Solution of Transmission line problems using Smith chart. Single Stub and Double Stubmatching.	12
MODULE 5	Types of transmission line (wave guide, microstrip) - brief introduction, applications andlimitations.	4
TEXT BOOK	1. Elements of Electromagnetic by Mathew N.O.Sadiku, OxfordUniversityPress. 2. Microwave Engineering by D. M. Pozar, John Willy &Sons.	
REFERENCE BOOK	1. Electromagnetic Fields Theory Fundamental, B.S.Guru&HuseynR. Hiziroglu, Thomson Asia Pvt.Ltd.Singapore 2. Electromagnetic Waves and Radiating Systems, E.C.Jordan&K.G.Balmain, PHIpublication 3. Microwave Devices and Circuits, Samuel Y, Liao, PearsonEducation	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Understand the Vector calculus and to be familiar with orthogonal co-ordinate system.
CO2	Analyze the basic laws related to the electrostatic and electromagnetic field.

CO3	Demonstrate Maxwell's equation and deduction of EM wave propagation equations.
CO4	Understand the parameters related to medium and nature of EM wave propagation.
CO5	Evaluate different type of high frequency transmission lines used at microwave frequency.

Relationship of Course Outcomes (CO) to Program Outcomes (PO) **1 – Low** **2 – Moderate** **3 – High**												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	2	3	2	2	-	2
CO2	3	3	2	3	3	-	3	2	3	3	-	3
CO3	3	3	3	3	3	-	3	3	3	3	-	2
CO4	3	3	3	1	2	-	3	3	3	2	-	3
CO5	3	3	2	2	3	-	2	2	2	2	-	3

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	**3**	**3**	**3**	**2**	**3**	**-**	**3**	**3**	**3**	**2**	**-**	**3**

ORGANIZATIONAL BEHAVIOUR Credit- 3-0-0 Class Hours – 30 (BHU2301)

Syllabus
Module I (6 hours)
Fundamentals of OB: Learning objectives, Definition, scope and importance of OB, why to study OB, Relationship between OB and the individual, Evolution of OB, Theoretical framework
(cognitive), Behavioristic and social cognitive, Models of OB, New Challenges of OB Manager,Limitations of OB
Learning: Nature of learning, Determinant of learning, How learning occurs, Learning and OB
Case Study Analysis
Module II (6 hours)
Personality: Definition and importance of personality for performance, Nature and Determinants of personality, Theories of Personality, Personality Traits, Personality and OB
Perception: Meaning and concept of perception, Perceptual process, Importance of perception in OB
Motivation: Definition & Concept of Motive & Motivation, Theories of Motivation (Herzberg's Two Factor model Theory, Maslow's Need Hierarchy, Aldefer's ERG theory)
Case Study Analysis

Module III (6 hours)
Communication: Importance, The Communication Process, Types of communication, Barriers to communication, Communication networks, Making communication effective
Groups in organization: Nature, Types of Groups, Why do people join groups? Stages of Group
Development, Group cohesiveness, Group decision making and managerial implication,
Developing Work Teams, Team Building, Effective team building
Leadership: Concept of Leadership, Styles of Leadership, Theories of leadership (Trait theory,
Behavioral theory, Contingency theory), How to be an effective leader, Success stories of
today's Global and Indian leaders.
Case Study Analysis

Module IV (6 hours)
Conflict: Nature of conflict, Sources of Conflict, Conflict resolutions, Stages of conflict episode,Conflict management technique
Transactional Analysis (TA): Meaning of TA, Ego states, Types of transactions, Life position
Case Study Analysis
Module V (6 hours)
Organizational Change: Why organizational change? Types of Organizational Change, Planned change, Kurt Lewin's-Three step model, Resistance to Change, Managing resistance to change. Organizational Culture: Meaning & definition, Types of culture, creating, sustaining and
changing a culture, Concept of workplace spirituality.
International OB: Introduction to International business, Individual and group behavior in
International organization, How culture influence International OB?
Case Study Analysis

Reference Books
1. Stephen P. Robbins, Organizational Behaviour, Printice Hall of India, New Delhi, 2013
2. K. Aswathappa, Organizational Behaviour, Himalaya Publishing House, Bombay, 2018
3. Nelson, D. L., and Quick, J. C. (2007)., Understanding Organizational Behaviour (3rded.).,
Thompson South-Western Publication
4. Pareek, U. (2012), Understanding Organizational Behaviour (3rded.)., Oxford University
Press.

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

CO1	Explain the transition process of management thought from traditional period to modern approaches**.**
CO2	Transfer the different motivational theories and evaluate motivational strategies used in a variety of organizational settings.
CO3	Identify and analyze the factors affecting individual and group behavior and evaluate the appropriateness of various leadership styles.
CO4	Evaluate the appropriateness of various conflict management strategies used in organizations and develop strategies for resolving group conflict.
CO5	Explain how organizational change and culture affect working relationships within organizations.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	3	1	-	3	2
CO2	-	-	-	-	-	1	2	2	3	-	-	-
CO3	-	-	-	-	-	2	2	3	3	-	3	-
CO4	-	-	-	-	-	-	1	2	1	-	1	1
CO5	-	-	-	-	-	3	1	3	2	-	3	3

Program Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	-	-	-	-	-	**2**	**2**	**3**	**2**	-	**3**	**2**

SESSIONAL

DIGITAL SYSTEM DESIGN LAB (BEC2494)

Experiment No.	CONTENT
1	Implementation of various logic gates using universal NAND and NOR gates
2	Gate level minimization and Implementation of two level and multilevel Boolean functions
3	Design and test of ADDER and SUBTRACTOR circuits.
4	Design and test of Binary to Gray and Gray to Binary Converter Circuits and study of 7-segment Display
5	Study of 8:1/16:1 Multiplexer and Implementation of Boolean function using Multiplexer
6	Design, Test and verification of SR, JK, D and T flip flop
7	Investigation of various shift registers
8	Design and Test of 2 bit UP and DOWN Counters
9	VHDL/ Verilog Simulation of combinational circuits
10	VHDL/ Verilog Simulation of sequential Circuit

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze fundamentals of digital electronics logic circuits.
CO2	Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder.
CO3	Demonstrate different types of flip flops circuit.
CO4	Analyze the synchronous sequential logic circuits.
CO5	Demonstrate the use of the HDL & appropriate EDA tools for digital logic design and simulation.

Relationship of Course Outcomes (CO) to Program Outcomes (PO) **1 – Low** **2 – Moderate** **3 – High**												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2	3	-	3	3	2	3
CO2	3	3	3	3	3	2	3	2	3	3	3	3
CO3	3	3	3	3	3	2	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3	1	3	3	3	2
CO5	3	3	3	3	3	3	3	3	3	3	3	1

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**

ADVANCED ELECTRONIC CIRCUITS LAB (BEC2498)

Experiment No.	CONTENT
1	Design and testing of second order low pass and high pass filter.
2	Design and testing of comparator circuit.
3	To realize a self-biased transistor binary circuit.
4	To get the response of Schmitt trigger circuit.
5	To realize a collector coupled monostable.
6	To realize a emitter coupled astablemultivibrator.
7	Design and testing of a voltage doubler circuit.
8	Design of a time base generator circuit.

SESSIONAL OUTCOME: After completion of the sessional student should be able to

1. Explain different filter applications in circuit design

2. Work on improvement of frequency response of theamplifiers.

3. Analyze the square wave generatorcircuits.

4. Separately explain the working principle of differentmultivibrators.

5. Explain the operation of a time base generatorcircuit.

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze different filter applications in circuit design.
CO2	Demonstrate the improvement of frequency response of the amplifiers.
CO3	Analyze the square wave generatorcircuits.
CO4	Analyze the working principle of differentmultivibrators.
CO5	Demonstrate the operation of a time base generator circuit.

Relationship of Course Outcomes (CO) to Program Outcomes (PO)
1 – Low 2 – Moderate 3 – High

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2	3	-	3	3	2	3
CO2	3	3	3	3	3	2	3	2	3	3	3	3
CO3	3	3	3	3	3	2	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3	1	3	3	3	2
CO5	3	3	3	3	3	3	3	3	3	3	3	1

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	3	3	2	3	2	3	3	3	2

ANALOG AND DIGITAL COMMUNICATION LAB (BEC2499)

Experiment No.	CONTENT
1	Write MATLAB program for generation and detection of i) DSB-SC ii) SSB-SC
2	Study of balanced modulator and detector of AM signal (using H/W Kit-C020).
3	To study amplitude modulated waveforms for different modulation depths and measure the value of modulation index (using H/W Kit- C09A).
4	To study the demodulation process and measure detection efficiency (using H/W Kit- C009).
5	To generate and detect frequency modulation (FM) signals using Kits and MATLAB.
6	PCM Based Transmitter and Receiver(Both using Kit and MATLAB)
7	Delta Modulation and Adaptive Delta Modulation Transmitter and Receiver
8	Generation and Detection of PSK, DPSK and QPSK signal
9	Generation and Detection of FSK and MSK signal
10	To study TDM using commutator and decommutator

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze the outputs of different analog modulation techniques.
CO2	Demonstrate the outputs of different digital modulation technique.
CO3	Demonstrate analog modulators and demodulators.
CO4	Implement and simulate digital modulators and demodulator.
CO5	Implement analog and digital modulator.

Relationship of Course Outcomes (CO) to Program Outcomes (PO) **1 – Low 2 – Moderate 3 – High**												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2	3	-	3	3	2	3
CO2	3	3	3	3	3	2	3	2	2	2	3	3
CO3	3	3	2	3	3	2	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3	1	2	2	3	2
CO5	3	3	2	3	3	3	3	3	2	2	3	1

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	3	3	2	3	3	2	3	2	2	2	3	2

Design & Testing Lab (BEC2496)

Experiment No.	CONTENTS
1	Design, Construction and Test of Biasing Circuits.
2	Design, Construction and Test of Voltage Amplifier Circuits.
3	Design, Construction and Test of Rectifier Circuits with Filters.
4	Design, Construction and Test of Voltage Regulator Circuits.
5	Design, Construction and Test of Oscillator Circuits.
6	Design, Construction and Test of Power Amplifier Circuits.
7	Design, Construction and Test of Multivibrator Circuits.
8	Design, Construction and Test of Current Time base Generator Circuits.
9	Design, Construction and Test of Voltage Time base Generator Circuits
10	Design, Construction and Test of AND gate, OR gate, NOT gate

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze the characteristics, operation and limitations of various circuits.
CO2	Demonstrate the testing strategies and select proper instruments to evaluate performance characteristics of electronic circuits.
CO3	Evaluate the testing and experimental procedures on different types of electronic circuit and analyze their operation under different operating conditions.
CO4	Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory so that, they will able to understand the practical issues related to practical implementation of applications using electronic circuits
CO5	Implement an application for social benefit.

Relationship of Course Outcomes (CO) to Program Outcomes (PO)
1 – Low 2 – Moderate 3 – High

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2	3	-	3	3	2	3
CO2	3	3	3	3	3	2	3	2	3	3	3	3
CO3	3	3	3	3	3	2	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3	1	3	3	3	2
CO5	3	3	3	3	3	3	3	3	3	3	3	1

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	3	3	2	3	2	3	3	3	2

FIFTH SEMESTER

MICROPROCESSORS AND MICROCONTROLLERS (BEC2507)

MODULE	CONTENT	HOURS
MODULE 1	Introduction to Microprocessor, Intel 8085 Microprocessor: Architecture, pins & signals, Register organization, Timing &control unit, Instruction Timing & Execution, Instruction set of 8085, Memory & I/O Addressing, Assembly language programming using 8085 instructions set.Stack& Subroutines, Restart, Conditional Call and Return Instructions, Advanced Subroutine Concepts,Interrupts.	8
MODULE 2	Intel 8086: introduction, pins & signal description, Architecture, Bus timing, minimum mode 8086, and maximum mode 8086, Instruction formats, Addressing modes, Instruction set: data transfer instruction,arithmetic and logic instruction, program control instructions, Assembly language programming with 8086,8086	9
	interrupts, Parameter passing.	
MODULE 3	Intel 80486: Architecture, Register Organization, Protected mode, Paging, Virtual mode.Salient features of Pentium Processor.	8
MODULE 4	Introduction to 8051 assembly language programming, The Program Counter and ROM space in the 8051,Flag Bits and PSW Register, Register Banks and Stack, Loop and Jump instruction, Call instruction, Time delay ,I/O port programming, Addressing modes.	8
MODULE 5	Programmable peripheral Interface: 8255, Programmable DMA Controller: 8257, Programmable Interrupt Controller: 8259, Programmable Interval Timer: 8253.Memory Interfacing.	7
TEXT BOOK	1. Microprocessor Architecture, programming and applications with the 8085 by R.S. Gaonkar, Penram International, India. 2. Microprocessors and Microcontrollers by N.Senthil Kumar, M.Saravanan, and S.Jeevananthan, Oxford UniversityPress. 3.M.A.Mazidi,&J.G.Mazidi:The 8051 Microcontroller and Embedded Systems, Pearson Education, India.	
REFERENCE BOOK	1. Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing by A.K.Ray and K.M.Bhurchandi,TMH 2. Intel Microprocessors: Architecture, Programming and Interfacing by Barry B.Bray,PHI.	

Course Outcomes: Upon completion of the subject the students will demonstrate the ability to:

CO1	Implement and solve basic binary math operations using the microprocessor and explain the microprocessor's and Microcontroller's internal architecture and its operation within the area of manufacturing andperformance..
CO2	Analyze and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller.
CO3	Evaluate the accepted standards and guidelines to select appropriate Microprocessor (8085 & 8086) and Microcontroller to meet specified performancerequirements..
CO4	Analyze assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor andmicrocontroller.
CO5	Demonstrate the electrical circuitry to the Microprocessor I/O ports in order to interface the processor to externaldevices.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	2	-	-	-	-	-	3
CO2	3	3	3	2	3	2	-	-	-	-	-	3
CO3	3	3	3	2	3	2	-	-	-	-	-	3
CO4	3	3	3	2	2	2	-	-	-	-	-	3
CO5	3	3	3	2	3	2	-	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	2	3	2	-	-	-	-	-	3

INTEGRATED CIRCUITS AND SYSTEMS (BEC2506)

MODULE	CONTENT	HOURS
MODULE 1	Introduction to VLSI Systems: Introduction to IC Technology, VLSI Design methodology, Design domains-Y chart, Hierarchical Abstraction, VLSI Design flow, VLSI Design styles, CAD tools for VLSI Design, NMOS and CMOS Fabrication Process, Design rules	6
MODULE 2	MOS Transistor: The Metal Oxide Semiconductor (MOS) structure, The MOS system under external bias, structure and operation of MOS transistor, MOSFET Scaling ,MOSFETCapacitances MOS Inverter Static Characteristics: Introduction, Resistive load inverter, CMOS inverter MOS Inverter dynamic Characteristics: Introduction, Delay time definitions, calculation of Delay times, Inverter design with delay constraints, Calculation of interconnect delay, Switching power dissipation of CMOS inverters	10
MODULE 3	Digital CMOS Logic Design: Digital logic gates Design, Combinational logic circuits, Flip-flops (SR, JK, D,T), Pseudo-nMOS logic, CMOS Transmission gate, Dynamic CMOS logic circuit, Domino CMOS logic, NORA CMOS logic, Zipper CMOS logic, Pass Transistor logic, Complimentary Pass Transistor logic, Differential CMOS Logic, Adiabatic logic, Semiconductormemories	8
MODULE 4	Timing Analysis: Introduction, Delay in VLSI circuits, Delay in CMOS inverter, Slew Balancing, Transistor Equivalency, Effect of Transistor size on propagation delay, design of logic gates for Equal Rise and Fall Slew. Inverter sizing effect on Propagation delay, Logical Effort Physical Design: Introduction, Floorplanning, Placement, Routing BiCMOS Technology: BiCMOS Technology, BiCMOS logic circuits, BiCMOS Two–input NAND logic, Complex Logic using BiCMOS.	8
MODULE 5	VLSI Testing: Introduction, Fault Models, Fault simulation, Design for Testability, Ad Hoc Testing, Scan Test, Built In Self-Test (BIST), IDDQ test, Yield. Digital Design using Verilog: Introduction, VerilogNaming Conventions, Operators in Verilog, Verilog Data types, BehaviouralModelling, Structural Modelling, Combinational and Sequential	8
	Logic in Verilog	

TEXT BOOK	1. Kang, S. M., &Leblebici, Y. (2003). *CMOS digital integrated circuits*. Tata McGraw-HillEducation. 2. Das, D. (2015). *VLSI design*. Oxford UniversityPress.
REFERENCE BOOK	1. Weste, N. H., & Harris, D. (2015). *CMOS VLSI design: a circuits and systems perspective*. Pearson EducationIndia. 2. Rabaey, J. M., Chandrakasan, A. P., &Nikolic, B. (2002). *Digital integrated circuits* :Prenticehall. 3. Palnitkar, S. (2003). *Verilog HDL: a guide to digital design and synthesis*. Pearson EducationIndia.

Course Outcomes: Upon completion of the subject the students will demonstrate the ability to:

CO1	Demonstrate a clear understanding of CMOS fabrication flow and technologyscaling.
CO2	Analyze CMOS based logic circuit.
CO3	Evaluate the logic circuits with different designstyles.
CO4	Demonstrate an understanding of working principles of clocking, power reductionand distribution of VLSICircuits.
CO5	Analyze the basics of Fabrication and Layout of CMOS Integrated Circuits.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	3	3	-	-	-	3	3
CO2	3	3	2	3	3	3	3	-	-	-	3	3
CO3	3	3	2	2	2	2	3	-	-	-	3	3
CO4	3	3	2	3	3	3	3	-	-	-	3	3
CO5	3	3	3	2	3	3	3	-	-	-	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	3	3	2	3	3	3	3	-	-	-	3	3

DIGITAL SIGNAL PROCESSING (BEC2503)

MODULE	CONTENT	HOURS
MODULE 1	Signals: Representation of signals on orthogonal basis , sampling and reconstruction of signals , Discrete time signals/sequences, Discrete time systems. The z-transform, Analysis of LSI/LTI systems using z-transform, Properties of z-transform	8
MODULE 2	Inversion of z-transform, The one sided z-transform ,implementation of discrete time systems. Frequency analysis of LTI systems :Discrete fouriertransform(DFT),frequency domain sampling ,Properties of DFT, Frequency	8
	analysis signals using DFT.	
MODULE 3	Efficient computation of DFT: circular convolution , circular correlation, linear filtering methods based on DFT. Fast fourier transform (FFT):Decimation in time (DIT) algorithm, Decimation in frequency (DIF) algorithm, Application of FFT.	8
MODULE 4	Realization of FIR and IIR systems using direct forms and cascaded forms. Design of Digital filters :General considerations. Design of FIR filters: window method. Design of IIR filters: Impulse invariance method, bilinear transformation method for analog filters	8
MODULE 5	Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation, Application of DSP.	8
TEXT BOOK	1.Digital Signal Processing By J.G.Proakis,D.G.Manolakis, 2. Digital Signal Processing ByS.Salivahanan,A.Vallavaraj,C.Ganapriya	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze and characterize signals and systems.
CO2	Analyze digital systems in time and frequency domain
CO3	Demonstrate digital system characterization through DFT and FFT.
CO4	Implement digital filters and systems.
CO5	Demonstrate signal spectral estimation methods.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	1	-	-	2	1	3
CO2	3	3	3	2	2	2	2	-	-	1	2	3
CO3	3	3	3	2	3	1	2	-	-	2	2	3
CO4	3	3	3	3	3	1	2	-	-	2	2	3
CO5	3	3	2	3	3	2	2	-	-	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	2	3	2	2	-	-	2	2	3

PROFESSIONAL ELECTIVE – I

Industrial Electronics (BECPE501)

MODULE	CONTENT	HOURS
MODULE 1	*DC amplifiers* Need for dc amplifiers, Drift, causes, Darlington, Emitter Follower, Cascode amplifier, Stabilization, Chopper Stabilization, Operational amplifier, Ideal specification of Instrumentation amplifier.	8
MODULE 2	*Regulated Power supplies* Block diagram, Principle of voltage regulation, Series and shunt type voltage regulators, Switched mode and IC voltage regulators, Fixed and adjustable voltage regulators, 3-terminal voltage regulators – current boosting.	8
MODULE 3	*SCR and Thyristor* Principles of operation and characteristics of SCR, Triggering of Thyristors, Commutation techniques of Thyristors, Ratings of SCR, Protection of SCR, Firing circuits, DIAC and TRIAC.	8
MODULE 4	*Application of SCR in power control* Single phase Converters – Half wave and Full wave with R, RL and RLE type load, Single phase Inverters – Half bridge and Full bridge types, Chopper circuits – Principle, methods and configurations.	8
MODULE 5	*Industrial Applications* Electronic DC motor control, Electronics timer, Electric welding – Resistance and ARC welding, Heating – Induction and Dielectric heating, Thermal losses, Ultrasonics – Generation and Applications	8
TEXT BOOK	1. G. K. Mithal and M. Gupta, Industrial and Power Electronics – Khanna Publishers, 19th Ed., 2003. 2. P.S. Bimbhra, Power Electronics – Khanna Publishers, 4th Ed.,2012	
REFERENCE BOOK	1. M. Rammurthy, Thyristors and applications – East West Press, 1997. 2. J. Milman and C. C. Halkias, Integrated Electronics, McGraw Hill,1972.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze dc amplifiers, Instrumentation amplifiers.
CO2	Analyze power supplies and regulators
CO3	Applyfundamentals and SCR along with methods triggering and commutation.

CO4	Implement SCR in powercontrol.
CO5	Demonstrate various industrial applications.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	3	2	3	-	-	-	-	1
CO2	3	2	3	3	3	3	3	-	-	-	-	1
CO3	2	1	1	3	2	2	1	-	-	-	-	1
CO4	3	2	3	3	3	2	3	-	-	-	-	1
CO5	3	2	2	3	2	3	3	-	-	-	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	2	3	3	2	3	-	-	-	-	1

Speech & Audio Processing (BECPE502)

MODULE	CONTENT	HOURS
MODULE 1	Introduction- Speech production and modelling - Human Auditory System;General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid; Requirements of speech codecs – quality, coding delays, robustness.	8
MODULE 2	Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation. Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.	8
MODULE 3	Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types. Scalar Quantization of LPC-Spectral distortion measures, Quantization based on reflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.	8
MODULE 4	Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and Decoders; Voicing detection; Limitations of the LPC model.Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; GenericCELP encoders and decoders; Excitation codebook search – state-save method, zero-input zerostate method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.	8
MODULE 5	Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards.	8
TEXT BOOK	*1.* Digital Speech by A.M. Kondoz, Second Edition (Wiley Students Edition),2004. 2. Speech Coding Algorithms: Foundation and Evolution of Standardized Coders,W.C. Chu, Wiley Inter science,2003.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze dc amplifiers, Instrumentationamplifiers.
CO2	Analyze power supplies and regulators
CO3	Express the concept ofSCR in powercontrol.
CO4	Implement SCR in powercontrol.
CO5	Analyse various industrialapplications.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	3	2	3	-	-	-	-	1
CO2	3	2	3	3	3	3	3	-	-	-	-	1
CO3	2	1	1	3	2	2	1	-	-	-	-	1
CO4	3	2	3	3	3	2	3	-	-	-	-	1
CO5	3	2	2	3	2	3	3	-	-	-	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	2	3	3	2	3	-	-	-	-	1

OPTOELECTRONICS & OPTICAL COMMUNICATION (BECPE503)

MODULE	CONTENT	HOURS
MODULE 1	Overview of optoelectronics: Fundamental of fiber optics, Different generations of optical fiber communication systems. Optical fiber structure, Fiber types, step index fiber and graded index fiber, ray propagation, total internal reflection, numerical aperture, acceptance angle. Wave propagation in a cylindrical wave guides, modal concept, V-number, power flow in step index fiber and graded index fiber.	8
MODULE 2	Transmission characteristics of optical fibers: Attenuation, Material absorption, Scattering loss, Bending loss, Dispersion (inter and intramodal, chromatic, wave guide) in fiber, dispersion shifted and dispersion flattened fiber, Polarization (Modal birefringence).	8
MODULE 3	Fabrication of fibers : Preparation of optical fibers, liquid phase melting techniques, Vapour phase deposition techniques, Optical fiber splices, connectors, couplers, Measurement techniques like OTDR.	8
MODULE 4	Optical sources - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsivity, noise, Optical receivers. Optical switches, Optical amplifiers - EDFA, Raman amplifier.	8
MODULE 5	Optical link design - BER calculation, quantum limit, power penalties. WDM and DWDM systems. Principles of WDMnetworks.	8
TEXT BOOK	1. Optical Fiber Communications, Keiser G, Tata McGraw Hill Education Private Limited, 4th Edition. 2. Optical Fiber Communication Principles and practice, Senior J, Prentice Hall of India. 3. Fiber optics and Optoelectronics, R.P.Khare, Oxford UniversityPress.	
REFERENCE BOOK	1. Fiber optic communications, Joseph C Palais, fourth edition, Pearson Education. 2. Semiconductor Optoelectronic Devices, PallabBhatttacharya, second edition, PearsonEducation. 3. Opticalfibrestelecommunications,S.E.MillerandA.G.Chynoweth,eds., Academic Press, 1979.	

Course Outcomes:

Upon completion of the subject, the students will demonstrate the abilityto:

CO1	Analyze the basic elements of optical fiber transmission link, fiber modes,

	configurationsandstructures.
CO2	Analyze the different kind of losses, signal distortion in optical wave-guides and their signal degradationfactors.
CO3	Express the fabrication of optical fiber and various measurement techniques associated with optical communication.
CO4	Implement the construction, working and characteristics of optical sources, detectors and apply the knowledge of optical amplifiers in the design of optical link &analyse the performance of opticalamplifiers..
CO5	Analyze and implement optical fiber link design.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	2	-	-	-	-	1
CO2	3	3	3	3	3	2	2	-	-	-	-	1
CO3	3	3	3	3	2	2	2	-	-	-	-	1
CO4	3	3	3	2	2	2	2	-	-	-	-	1
CO5	3	3	3	2	1	2	1	-	-	-	-	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	3	2	2	2	-	-	-	-	1

SESSIONAL

MICROPROCESSORS AND MICROCONTROLLERS LAB (BEC2595)

Experiment No.	CONTENT
1	Programs for 8 bit arithmetic operations for 8085 (using various addressing modes)
2	Bit manipulation instructions like checking: i) Whether given data is positive or negative ii) Whether given data is odd or even
3	Branch/ Loop instructions like i) Arrays: addition/subtraction of N nos. ii) Finding largest and smallest nos.
4	16-bit Multiplication and Division using 8086.
5	Binary to Gray and Gray to Binary code conversion using 8086.
6	BCD addition of a given set of numbers using 8086.
7	Programming using arithmetic, logical and bit manipulation instructions of 8051.
8	LED blinking using 8051.
9	Stepper motor interfacing using 8051.
10	Generation of square wave using 8051.

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Express and solve basic binary math operations using the microprocessor and explain the microprocessor's and Microcontroller's internal architecture and its operation within the area of manufacturing andperformance.
CO2	Implement the knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor andmicrocontroller.
CO3	Express the accepted standards and guidelines to select appropriate Microprocessor (8085 & 8086) and Microcontroller to meet specified performancerequirements..
CO4	Analyse assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor andmicrocontroller.
CO5	Demonstrate electrical circuitry to the Microprocessor I/O ports in order to interface the processor to externaldevices.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	-	-	-	-	-	3
CO2	3	3	3	2	2	2	-	-	-	-	-	3
CO3	3	3	3	2	2	2	-	-	-	-	-	3
CO4	3	3	3	2	2	2	-	-	-	-	-	3
CO5	3	3	3	2	2	2	-	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO	3	3	3	2	2	2	-	-	-	-	-	3

INTEGRATED CIRCUITS & SYSTEM LAB (BEC2596)

Experiment No.	CONTENT
1	Design of Half adder and Half subtractor using Verilog HDL.
2	Design of Full adder , 4-bit binary adder and Multiplexers using Verilog HDL
3	Design of 4-bit Multiplier using Verilog HDL.
4	Design a parity generator and comparator using Verilog HDL.
5	Design an 8-bit ALU using Verilog HDL.
6	Design of D, RS & JK flip-flop using Verilog HDL.
7	Design of MOD-10 up down counter using Verilog HDL.
8	Design of FSM based sequence detector using Verilog HDL.
9	Design of FSM based Vending Machine using Verilog HDL.
10	Study of Transfer/Transient Characteristics of the following Logic Circuits using Gate Logic / Switch Logic a. CMOS Inverter. b. Two input NAND/AND gate c. Two input NOR/OR gate.
SUPPLEMENTARY BOOK(If Any)	1. Palnitkar, S. (2003). *Verilog HDL: a guide to digital design and synthesis*. Pearson EducationIndia. 2. Brown, S. D. (2007). *Fundamentals of digital logic with Verilog design*. Tata McGraw-HillEducation.

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze different types of digital electronic circuit using various mapping and logicaltools.
CO2	Implement competence in Combinational Logic Problem formulation and Logic Optimisation.
CO3	Implement competence in analysis of synchronous and asynchronous sequentialcircuits.
CO4	Analysein various simulation softwares like Xilinx ISE, Vivado and Modelsimetc.
CO5	DemonstrateVLSI circuits on FPGAboards.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	3	3	-	-	-	3	2
CO2	3	3	2	3	3	2	3	-	-	-	3	2
CO3	3	3	2	2	2	3	3	-	-	-	3	2
CO4	3	3	2	3	2	3	3	-	-	-	3	2
CO5	3	3	3	2	2	3	3	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	2	3	2	3	3	-	-	-	3	2

DIGITAL SIGNAL PROCESSING LAB-1 (BEC2593)

Experiment No.	CONTENT
1	Study of Z-transforms.
2	Study of DFT.
3	Study of FFT systems.
4	Study of DIT & DIF systems.
5	Realization of FIR systems.
6	Realization of IIR systems.
7	Computation spectral estimation.

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze different types of transformations.
CO2	Implement and modify of LTIsystems.
CO3	Analyzethe performance of DIT &DIFalgorithms.
CO4	Implement IIR &FIRsystems.
CO5	Demonstrateconclusions after computingPSD.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	3	2	-	-	2	3	3
CO2	3	3	2	2	3	3	2	-	-	2	3	3
CO3	3	3	2	2	3	3	2	-	-	2	3	3
CO4	3	3	2	2	3	3	2	-	-	2	3	3
CO5	3	3	2	2	3	3	2	-	-	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	2	2	3	3	2	-	-	2	3	3

SIXTH SEMESTER

MICROWAVE ENGINEERING (BEC2603)

MODULE	CONTENT	HOURS
MODULE 1	Waveguides: Rectangular waveguides, Field solution for TE and TM modes, Design of Rectangular waveguides to support Dominant TE_{10} only. Cylindrical waveguides - Dominant mode. Design of cylindrical waveguides to support dominant TE_{11} mode.	6
MODULE 2	N-port networks- Properties of S matrix & their relationships to Transmission matrix, Microwave passive components: Attenuators, Phase shifter, Directional coupler, Waveguide Tees, hybrid ring, Circulators, Isolators, S - matrix representation of Directional coupler, Waveguide Tees, hybrid ring,Circulator.	8
MODULE 3	Microwave Filters: Periodic structures, Filter design by image parameter method; Constant-k filter section, m-derived filter section, and composite filter. Microwave amplifier design: Two-port power gains, Stability, Single stage transistor amplifier design.	10
MODULE 4	Microwave Sources: Reflex Klystron: Velocity Modulation, Power output and frequency versus Reflector voltage Electronic Admittance. Multi Cavity Magnetron: Principle of operation, Rotating field, π-mode of operation, Frequency of oscillation. The ordinary type (O-type) travelling wave tube- Construction features, principle of operation as an amplifier, Gunn oscillator (principle).	12
MODULE 5	Microwave Propagation: Line of sight propagation. Attenuation of microwaves by Atmospheric gases, water vapors & precipitates.	4
TEXT BOOK	Microwave Engineering by D. M. Pozar, John Willy & Sons. Microwave Devices and Circuits, Samuel Y, Liao, Pearson Education	
REFERENCE BOOK	1. Foundation for Microwave Engineering, R. E. Collin, WileyPublication. 2. Microwave Engineering, A Das & S Das,TMH. 3. Microwave Devices & Circuit Design , GP Srivastava& VL Gupta,PHI.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze the limitations of vacuum tubes and solid state Devices at microwave frequencies.
CO2	Express the design of rectangular and cylindrical waveguides at highfrequency.
CO3	Apply basic principles of high frequency microwave circuits like filters andamplifiers.
CO4	Analyze detail working of various microwavesources.
CO5	Demonstrate microwave propagation in atmosphericcondition.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	3	3	3	3	-	-	-	-	3
CO2	2	3	3	3	2	3	3	-	-	-	-	3
CO3	3	2	3	3	2	3	3	-	-	-	-	3
CO4	3	3	3	3	2	3	3	-	-	-	-	3
CO5	2	2	3	3	2	3	3	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	3	3	3	2	3	3	-	-	-	-	3

WIRELESS & MOBILE COMMUNICATION (BEC2606)

MODULE	CONTENT	HOURS
MODULE 1	Concept of mobile and personal communication, wireless cellular platform, the design fundamentals of cellular networks, frequency reuse, spectrum capacity enhancement techniques, co-channel and adjacent channel interference, location management, handoff management; Concept of mobile IP for mobility management issues.	8
MODULE 2	Two-ray ground reflection model, a micro-cell propagation model, a macro-cell propagation model, shadowing model, large scale path loss and shadowing, multipath effects in mobile communication, linear time variant channel model; Concept of coherent bandwidth, Coherent time, Doppler Shift - Effect of velocity of the mobile, models for multipath reception, mobile communication antennas.	8
MODULE 3	Frequency division multiple access technology (FDMA), time division multiple access (TDMA), space division multiple access (SDMA), code division multiple access (CDMA); spectral efficiency of different wireless access technologies, spectral efficiency in FDMA system, spectral efficiency in a TDMA system, spectral efficiency for DSCDMA system.	8
MODULE 4	Architecture and protocols, access technology, call set up procedure, 2.5 G networks; evolution of GPRS, concept of data communication on GPRS, session management and PDP Context, data transfer through GPRS network and routing.	8
MODULE 5	Personal area networks (PAN), Public wide-area wireless networks, wireless Local Area Networks; Brief introduction to 3G – The universal mobile telecommunication system (UMTS) Basic idea of satellite mobile communication systems.	8
TEXT BOOK	1. Wireless Communications- Principles and Practice, T S Rappaport,Pearson Education India, Second Edition2003 2. Mobile Communication Engineering – Theory and Applications W C YLee, TMH Publication, Second Edition, 2008.	
REFERENCE BOOK	1. Mobile & Cellular Telecommunication by W.C.Y Lee.McGrawhill 2. Raymond Steele, Mobile Radio Communications, IEEE Press, NewYork, 1992.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Express the cellular system design and technicalchallenges.
CO2	Analyze the Mobile radio propagation, fading, diversity concepts and thechannel modeling.
CO3	Apply basic principles of Multi user Systems, CDMA,DSCDM.
CO4	Analyze data communication in GPRS.
CO5	Evaluatepersonal area network.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	3	2	3	3	-	-	-	-	3
CO2	2	3	3	3	2	3	3	-	-	-	-	3
CO3	2	3	3	3	2	3	3	-	-	-	-	3
CO4	2	3	3	3	2	3	3	-	-	-	-	3
CO5	2	3	3	3	2	3	3	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	3	3	3	2	3	3	-	-	-	-	3

PROFESSIONAL ELECTIVE – II

Electronic Instrumentation & Measurement (BEC2607)

MODULE	CONTENT	HOURS
MODULE 1	Basics of Measurements: Accuracy, Precision, resolution, reliability, repeatability, validity, Errors and their analysis, Standards of measurement. Bridge Measurement: DC bridges- wheat stone bridge, AC bridges – Kelvin, Hay, Maxwell, Schering and Wien bridges, Electronic Instruments for Measuring Basic Parameters: Amplified DC meter, AC Voltmeter, True- RMS responding Voltmeter, Electronic multi-meter, Digital voltmeter	12
MODULE 2	Oscilloscopes: Cathode Ray Tube, Vertical and Horizontal Deflection Systems, Probes and Transducers, Specification of an Oscilloscope. Oscilloscope measurement Techniques, Special Oscilloscopes –DSO, Sampling Oscilloscope,	10
MODULE 3	Signal Generators: Sine wave generator, Frequency – Synthesized Signal Generator, Sweep frequency Generator. Function Generators. Signal Analysis: Wave Analyzer, Spectrum Analyzer (Basic types).	8
MODULE 4	Frequency Counters: Simple Frequency Counter; Measurement errors; extending frequency range ofcounters Transducers: Types, Strain Gages, Displacement Transducers (Capacitive, LVDT). Temperature transducers (IC, RTD, Thermocouple, Thermistor) .	6
MODULE 5	Digital Data Acquisition System: Interfacing transducers to Electronics Control and Measuring System. Instrumentation Amplifier, Isolation Amplifier. An Introduction to Computer-Controlled Test Systems.IEEE-488 GPIB Bus	4
TEXT BOOK	1. Modern Electronics Instrumentation & Measurement Techniques, by Albert D.Helstrick and William D.Cooper, Pearson Education. Selected portion from Ch.1, 5-13. 2. Elements of Electronics Instrumentation and Measurement-3rd Edition by JoshphJ.Carr. Pearson Education. Selected portion from Ch.1,2,4,7,8,9,13,14,18,23 and25.	

REFERENCE BOOK	1. Electronics Instruments and Instrumentation Technology – Anand,PHI 2. Doebelin, E.O., Measurement systems, McGraw Hill, Fourth edition, Singapore, 1990.

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Demonstrate basic knowledge about measurement and measuringInstruments.
CO2	Express CRO circuits in details with special typesandapplications.
CO3	Apply basic principlessignal generators andanalyzers.
CO4	Express frequency counters and transducers.
CO5	Demonstratedigital data acquisition system and its implementation.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	-	-	-	-	-	2
CO2	3	3	2	2	2	2	-	-	-	-	-	2
CO3	3	3	2	2	2	2	-	-	-	-	-	2
CO4	3	3	2	2	2	2	-	-	-	-	-	2
CO5	3	3	2	2	2	2	-	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	2	2	2	2	-	-	-	-	-	2

SENSORS & TRANSDUCERS (3-1-0) PEII - (BECPE602)

MODULE	CONTENT	HOURS
MODULE 1	**INTRODUCTION TO MEASUREMENT:** Building blocks of Measurement Systems, Definition: Sensor & Transducer, Types and Classifications of sensor& transducers, Classification of errors in measurements, Static and dynamic characteristics of transducers.	8
MODULE 2	**VARIABLE RESISTANCE, VARIABLE INDUCTANCE AND CAPACITANCE TRANSDUCERS:** Potentiometer — strain gauge — resistance thermometer — hot wire anemometer — LVDT — variable reluctance transducers for measurement of dip and acceleration - Variable capacitive transducers —electromagnetic, thermo-elastic, capacitormicrophone.	10
MODULE 3	**PIEZOELECTRIC AND OPTICAL TRANSDUCERS:** Piezoelectric transducer — IC sensors — Piezo-resistive sensors, photoelectric, Hall-effect, Optical transducer-Principles — types and characteristics of fibres — fibre optic transducers for the measurement of force, temperature, flow andpressure.	10
MODULE 4	**Temperature transducers:** IC,RTD, Thermocouple, Thermistor, Optical Pyrometers.	6
MODULE 5	**INTERFACING CONVENTIONAL TRANSDUCERS WITH PC:** Transducers with frequency output — digital transducers, interfacing with PC. Instrumentation Amplifier, Isolation Amplifier. An Introduction to Computer-Controlled Test Systems.IEEE-488 GPIB Bus.	6
TEXT BOOK	1. A. K Sawhney&P.Sawhney- A course in Electrical and Electronic Measurements and Instrumentation, DhanpatRai& Company,2016. 2. D. Patranabis- Sensors and Transducers,PHI,2003.	
REFERENCE BOOK	1. D. Patranabis- Principle of Industrial Instrumentation, TMH,2000 2.E.O. Doebelin-Measurement systems, McGraw Hill, Fourth edition, Singapore, 1990. 3. D.V.S. Murty-Transducers and Instrumentation, PHI,2008.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Demonstrate the basics of measurement systems anderrors.
CO2	Implement type and classification of sensors andtransducers.
CO3	Apply different passive transducers used for measurement of temperature,flow
CO4	Express working & application of optical and piezoelectric transducers for measurement of basicparameters.
CO5	Demonstrate interfacing conventional transducers with PC to make them work asadaptive transducers.

Course Articulation Matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	2	2	-	-	-	-	3
CO2	3	3	3	3	1	2	2	-	-	-	-	3
CO3	3	3	2	3	2	2	2	-	-	-	-	3
CO4	3	3	2	3	2	2	2	-	-	-	-	3
CO5	3	3	2	2	1	2	2	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	3	3	2	3	2	2	2	-	-	-	-	3

BIOMEDICAL INSTRUMENTATION (BECPE603)

MODULE	CONTENT	HOURS
MODULE 1	**Introduction of Bio-medical Instrumentation:** Introduction to man-instrument system, components of the man-instrument system, Physiological system of the body, Problems encountered in measuring a livingsystem.	6
MODULE 2	**Sources of Bioelectric Potentials:** Resting and action potentials, Propagation of action potentials, Bioelectric potentials. **Biopotential electrodes:** Electrodes for ECG (Limb Electrode, Floating Electrodes, Disposable Electrodes), Electrodes for EEG, Electrodes for EMG, Biochemical transducers. Review of transducers.	6
MODULE 3	**Cardiovascular System and Measurements:** The heart and cardiovascular system, ECG, blood pressure and its measurement, respiration and pulse rate, characteristics and measurement of blood flow meter, cardiac output, plethysmography, pacemaker, defibrillators, heart sounds and its measurement.	10
MODULE 4	**Respiratory and Neuro-muscular System:** The physiology of the respiratory system, test and instrument for the mechanics of breathing, the somatic nervous system, EEG, EMG andGSR.	8
MODULE 5	**Measurement and Recording of Noninvasive Diagnostic Instrumentation, Patient Care and Electrical Safety:** Principle of ultrasonic measurement, ultrasonic, thermography, elements of intensive care monitoring, X-ray, CT – Scan and MRI, tonometer, dialysis, diathermy,Shock hazards from electrical equipment.	10
TEXT BOOK	1. Cromwell, L. and Weibell, F.J. and Pfeiffer, E.A., Biomedical Instrumentation and Measurement, Dorling Kingsley (2006) 2nded. 2. Carr, J.J. and Brown, J.M., Introduction to BiomedicalEquipment Technology, Prentice Hall (2000) 4thed.	
REFERENCE BOOK	1. Geddes, L.A., and Baker, L.E., Principles of Applied Biomedical Instrumentation, Wiley Inter Science (1989) 3rded. 2. Khandpur, R.S., Handbook of Biomedical Instrumentation, McGraw Hill (2003) 2nded. 3. Webster,J.G.,MedicalInstrumentationApplicationandDesign,John Wiley (2007) 3rd ed	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Demonstrate basic knowledge about biomedicalinstrumentations.
CO2	Implement Analyses the biomedical signal sources along with the required electrodes andtransducerstype and classification of sensors andtransducers.
CO3	Expresscardiovascular measurements and the requiredinstruments
CO4	Evaluatethe respiratory and nervous systems and relatedmeasurements.
CO5	Analyzemeasure non-invasive diagnostic parameters and learn safety measures during biomedical measurements.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	3	2	-	-	-	-	3
CO2	3	3	1	2	3	3	2	-	-	-	-	3
CO3	3	3	1	2	3	2	2	-	-	-	-	3
CO4	3	3	2	2	3	2	2	-	-	-	-	3
CO5	3	3	2	2	3	3	3	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	2	2	3	3	2	-	-	-	-	3

INTELLIGENT INSTRUMENTATION (BECPE604)

MODULE	CONTENT	HOURS
MODULE 1	**Background of Instrumentation:** Introduction, Classification of Classical Sensors and Transducers, Self-Generating Transducers, Variable Parameter Transducers, Radioactive Transducer, Semiconductor Sensors, Array-Based Sensors, Biosensors. **Intelligent Sensors:** Introduction, Comparison with conventional transducers, Classification, Smart Sensors, Cogent Sensors, Soft or Virtual Sensors, Self-Adaptive Sensors, Self-Validating Sensors, VLSI Sensors, Temperature Compensating Intelligent Sensors.	12
MODULE 2	**Introduction to Virtual Instrumentation:** Computers in instrumentation, What is Virtual instrumentation (VI), History of VI, LabVIEW and VI, Conventional and graphical programming, Distributed systems. **Basics of LabVIEW:** Components of LabVIEW, Owned and free labels, Tools and otherpalettes, Arranging objects, pop-up menu, Colour coding, Code debugging, Context sensitivehelp, Creating sub-Vis. **FOR and WHILE Loops:** The FOR loop, The WHILE loop, Additional loop problem, Loopbehaviour and interloop communication, Local variables, Global variables, Shift registers,Feedback, Autoindexing, Loop timing, Timed loop. **Other Structures:** Sequence structures, Case structures, Formula node, Event structure. **Arrays and Clusters:** Arrays, Clusters, inter-conversion of arrays andclusters. **Graphs and Charts:** Waveform chart, Resetting plots, Waveform	10
	graph, Use of cursors, X-Ygraph. **File Input/Output:** File formats, File I/O functions, Path functions, Sample VIs todemonstrate file WRITE and READ,Generatinf file names automatically. **String Handling:** String functions, LabVIEW string formats, Examples, Some more functions,Parsing of strings.	
MODULE 3	**Smart Sensors:** Smart transmitter with HART communicator — Micro Electro Mechanical Systems —sensors, actuators — principles of applications, nonlinearity compensation. **Basics of Data Acquisition:** Classification of signals, Read-world signals, Analog interfacing, Connecting the signal to the board, Guidelines, Practical versus ideal interfacing, Bridge signal sources.	6

MODULE 4	**Sensors with Artificial Intelligence:** Introduction, Sensors with Artificial Intelligence **State Machines:** What is a state machine? A simple state machine, Event structures, the fullstate machine, Notes and comments.	6
MODULE 5	**Interfacing Instruments:** GPIB and RS232: RS232C versus GPIB, Handshaking, GPIB interfacing, RS232C/RS485 interfacing, Standard commands for programmable instruments,VISA.	6
TEXT BOOK	1. M. Bhuyan, Intelligent Instrumentation Principles and Applications, CRC Press2011. 2. Sanjay Gupta and Joseph John-Virtual Instrumentation Using LabVIEW, 2nd Edn., Tata McGraw-Hill,2010. 3. Barney G.C.V., Intelligent Instrumentation: Prentice Hall of India Pvt.Ltd., New Delhi,1988.	
REFERENCE BOOK	1. D. Patranabis- Principle of Industrial Instrumentation,TMH,2000 2. Jerome Jovitha-Virtual Instrumentation Using Labview, PHILearning,, 2010. 3. P.Chapman,-Smart Sensors, ISA publication, 1995.	

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Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze different features of intelligenttransducers.
CO2	Implement basic tools ofLabView.
CO3	Demonstrate basics of data acquisitionsystem
CO4	Evaluate the application of artificial intelligent sensors and statemachine.
CO5	Expressinterfacing conventional transducers with PC to make them work as adaptive transducers.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2	-	-	-	-	3
CO2	3	3	3	3	3	3	2	-	-	-	-	3
CO3	3	3	3	3	3	3	2	-	-	-	-	3
CO4	3	3	3	3	3	3	2	-	-	-	-	3
CO5	3	3	3	2	3	3	2	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	3	3	3	2	-	-	-	-	3

PROFESSIONAL ELECTIVE – III

DIGITAL IMAGE PROCESSING [3-1-0] PEIII- (BEC2604)

MODULE	CONTENTS	HOURS
MODULE 1	Digital Image Fundamentals: Components of image processing system, image fundamentals, image sampling and quantization, basic relationships between pixels, color image fundamentals – RGB, YCbCr, HSI models, 2D-transforms – DFT, DCT, KLT, slant transform – properties and applications.	08
MODULE 2	Image Enhancement In Spatial Domain: Enhancement in spatial domain: basic gray level transformations, histogram processing, smoothing and sharpening of spatial filters.	08
MODULE 3	Image Enhancement In Frequency Domain: Enhancement in frequency domain: Introduction to filtering in frequency domain, smoothing and sharpening of frequency domain filters.	08
MODULE 4	Image Restoration: Degradation model, restoration in presence of noise only – spatial filtering, linear, position invariant degradations, estimating degradation functions, inverse filtering, Wiener filtering.	08
MODULE 5	Image Compression And Segmentation: Redundancy and compression models, Lossless coding – Run length coding, Huffman coding, vector quantization, JPEG Edge detection, Region based segmentation – region growing, region merging and splitting.	08
TEXT BOOKS	[1] Richard E. Woods, Rafael C. Gonzalez, Digital Image Processing, Pearson , 2004 [2] A. K. Jain, Fundamentals of Digital Image Processing, Pearson, 2002.	
REFERENCE BOOKS	[1] Richard E. Woods, S. Eddins, Rafael C. Gonzalez, Digital Image Processing using MATLAB, Pearson Education, Inc., 2004. [2] W. K. Pratt, Digital Image Processing, John Wiley, New York, 2002.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Demonstratesuitable 2-D transforms for certain application specific requirements.
CO2	Implement an image to select and apply a suitable image enhancement technique in spatial domain.

CO3	Demonstrate the frequency domain enhancement techniques in contrast to the spatial domain enhancement techniques
CO4	Evaluate and estimate degradation functions based on given degraded images.
CO5	Expressthe various redundancies to different compression techniques. Learner should be able to classify among various image segmentation techniques.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	3	1	3	-	-	-	-	2
CO2	3	3	3	2	2	1	3	-	-	-	-	2
CO3	3	3	3	2	2	1	3	-	-	-	-	2
CO4	3	3	3	2	3	2	3	-	-	-	-	2
CO5	3	3	3	3	3	3	3	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	2	3	2	3	-	-	-	-	2

LOW POWER VLSI DESIGN (BECPE606)

MODULE	CONTENTS	HOURS
MODULE 1	***Technology & Circuit Design Levels***: Sources of Power Dissipation in Digital ICs, Degree of Freedom, Recurring Themes in Low-Power, Emerging Low Power Approaches, Dynamic Dissipation In CMOS, Effects of V_{DD}& V_T on Speed, Constraints on V_T Reduction, Transistor Sizing & Optimal Gate Oxide Thickness, Impact of Technology Scaling, Technology Innovations.	08
MODULE 2	***Low Power Circuit Techniques***: Power Consumption in Circuits, Flip-Flops & Latches, High Capacitance Nodes, Energy Recovery, Reversible Pipelines, High Performance Approaches.	08
MODULE 3	***Low Power Clock Distribution***: Power Dissipation in Clock Distribution, Single Driver Versus Distributed Buffers, Buffers & Device Sizing Under Process Variations, Zero Skew Vs. Tolerable Skew, Chip & Package Co-Design of Clock Network.	08
MODULE 4	***Logic Synthesis for Low Power Estimation Techniques***: Power Minimization Techniques, Low Power Arithmetic Components-Circuit Design Styles, Adders, Multipliers.	08
MODULE 5	***Low Power Memory Design***: Sources & Reduction of Power Dissipation in Memory Subsystem, Sources of Power Dissipation In DRAM & RAM, Low Power DRAM Circuits, Low Power SRAM Circuits. ***Low Power Microprocessor Design System***: Power Management Support, Architectural Trade-Offs for Power, Choosing the Supply Voltage, Low-Power Clocking, Implementation Problem	08
	for Low Power, Comparison of Microprocessors for Power & Performance	
TEXT BOOKS	1. P. Rashinkar, Paterson and L. Singh, "*Low Power Design Methodologies*", Kluwer Academic,2002 2. Kaushik Roy, Sharat Prasad, "*Low Power CMOS VLSI Circuit Design*", John Wiley sonsInc.,2000. 3. Gary Yeap, "*Practical Low Power Digital VLSI Design*", Kluwer,1998.	
REFERENCE BOOKS	1. Rabaey, Pedram, *Low power design methodologies,* KluwerAcademic,1997 2. W. Nebel and J. Mermet, *Low Power Design in Deep Sub-micron Electronics,* Kluwer Academic Publishers,1997 3. B.Kulo and J.H Lou, "*Low voltage CMOS VLSI Circuits*", Wiley,1999. 4. A.P.Chandrasekaran and R.W.Broadersen, "*Low Power Digital CMOS Design*",Kluwer,1995	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyzethe sources of power dissipation in digital IC systems &understandthe impact of power on system performance andreliability.
CO2	Demonstrate various techniques for low power circuitdesign.
CO3	Expressthe clock distribution for low powercircuits
CO4	EvaluatePower Minimization Techniques of Logic Synthesis for LowPowerEstimationTechniques.
CO5	Demonstratedesign of Low power memory and Microprocessorsystems.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	3	2	3	-	-	-	-	3
CO2	3	3	3	2	2	2	3	-	-	-	-	3
CO3	3	3	3	2	2	2	3	-	-	-	-	3
CO4	3	3	3	2	3	2	3	-	-	-	-	3
CO5	3	3	3	3	3	3	3	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	2	3	2	3	-	-	-	-	3

SESSIONAL

MICROWAVE ENGINEERING LAB (BEC2693)

Experiment No.	CONTENT
1	Study of Microwave Components and Devices
2	Reflex Klystron Characteristics: i. Electronic Tuning Range, ii. Mode Curves, iii. Carrier Wave Operation and iv. Square Wave Operation
3	Measurement of Frequency and Wavelength in a rectangular waveguide working on TE_{10} mode.
4	Measurement of VSWR and Reflection coefficient by standing wave method.
5	Design of microwave filters circuit.
6	Measurement of attenuation of Fixed and Variable attenuator.
7	Measurement of Main Line and Auxiliary Line VSWR, Coupling Factor, Insertion Loss and Directivity of a Directional coupler.
8	Study of power division in E-plane and H-plane TEE.
9	Radiation pattern and Gain of Waveguide Horn antenna.
10	Design and Study of H-plane TEE (using CST/ HFSS).

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Express and use microwave components in laboratory and practical fieldrequirements.
CO2	Demonstrate the operation of high frequency transmissionline.
CO3	Evaluate attenuation, VSWR andDirectivity
CO4	Evaluatethe field pattern and gain of waveguide hornantenna.
CO5	Demonstratelatest EM software's for any designassignments.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	3	2	3	3	-	-	-	-	2
CO2	3	2	3	3	2	3	3	-	-	-	-	2
CO3	3	3	3	3	2	3	3	-	-	-	-	2
CO4	2	2	3	3	2	3	3	-	-	-	-	2
CO5	2	3	3	3	3	3	3	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	3	3	3	2	3	3	-	-	-	-	2

SIMULATION LAB II (BEC2695)

Experiment No.	CONTENT
1	Study of digital image and image formats. Conversion of color image to gray image using MATLAB
2	Basic gray level transformation – image negative, Log transformation, Power law transformation
3	To find histogram of a gray scale image and its equivalent histogram equalized image
4	Image smoothening – mean and median filters along with its variant applied on noisy image
5	Application of Laplacian, Sobel, Canny operator to determine the edge of an image
6	Frequency domain filtering [Ideal low pass, Butterworth low pass, Gaussian low pass] on noisy image.
7	Filtering and compression of image in wavelet domain.
8	Morphological operations on gray scale image
9	Color image processing – conversion of color image from RGB to HIS, CMY, YC_bC_r color space and vice versa
10	Affine transformations [scaling, translation and shear] on gray scale image.
SUPPLEMENTARY BOOK(If Any)	**1. R C Gonzalez, R E Woods, Digital Image Processing using MATLAB, Prentice Hall**

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze theoperational characteristic ofLVDT.
CO2	Demonstrate operation of different smoothing and sharpeningfilters.
CO3	Evaluate different de-noising models to recover originalimage
CO4	Analyse the different segmentationtechniques.
CO5	Implementimage processing operation in colorimages.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	2	3	2	-	-	-	-	2
CO2	2	2	3	3	2	3	2	-	-	-	-	2
CO3	2	2	3	3	2	2	2	-	-	-	-	2
CO4	2	2	3	3	2	2	1	-	-	-	-	2
CO5	2	2	3	3	2	3	2	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	3	3	2	3	2	-	-	-	-	2

INSTRUMENTATION LAB (BEC2691)

Experiment No.	CONTENT
1	Study input characteristics of LVDT and determination of linearity.
2	Study of the characteristics of LVDT and plotting the displacement-voltage graph.
3	Study the phase difference between secondaries of LVDT.
4	Determination of characteristics between strain applied to a beam and the output voltage for a Straingauge..
5	Study of IC Temperature sensor.
6	Study of resistance &temp -voltage characteristics of Thermistor.
7	Study of resistance &temp -voltage characteristics of RTD.
8	Measurement of temperature-voltage characteristics of Thermocouple.
9	Study the characteristics of Photoconductive cell.
10	Study the characteristics of Photovoltaic cell.

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze the operational characteristic ofLVDT.
CO2	Demonstrate principle of operation of and Straingauge.
CO3	Implement IC Temperature control system
CO4	Analyse the principle of operation of various temperature transducers like RTD,ThermistorandThermocouple.
CO5	Expressthe working principle and characteristics of optical transducers like photoconductive, photovoltaic andphotodiode.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	2	-	-	-	-	2
CO2	3	3	3	3	3	2	2	-	-	-	-	2
CO3	3	3	3	3	3	2	2	-	-	-	-	2
CO4	3	3	3	2	2	2	2	-	-	-	-	2
CO5	3	3	3	2	2	2	2	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	3	3	2	2	-	-	-	-	2

SEVENTH SEMESTER

WAVE PROPAGATION AND ANTENNA ENGINEERING (BEC2791)

MODULE	CONTENT	HOURS
MODULE 1	Radio Wave Propagation: Modes of propagation, Structure of Troposphere, Tropospheric Scattering, Ionosphere, Ionospheric Layers - D, E, F1, F2 regions. Sky wave propagation - propagation of radio waves through Ionosphere, Effect of earth's magnetic field, Virtual height, Skip Distance, MUF, Critical frequency, Space wave propagation.	6
MODULE 2	Antenna Definition, Principles of Radiation, Basic antenna parameters, Retarded Vector Magnetic Potential, Radiation field from Current element, Current Distribution on a thin Wire, Half wave dipole and Quarter wave monopole. Two-element array, Principle of Pattern Multiplication, Linear Array, Broadside and end fire array, Balun.	8
MODULE 3	Folded Dipole, Yagi Antenna. Frequency Independent Antenna. Log Periodic Dipole array. Horn Antennas-Pyramidal &Sectoral Horn. Radiation Pattern and Gain of horn antenna.	10
MODULE 4	Parabolic Reflector Antenna -Principle, Analysis, Radiation Pattern and Gain, Principles of Cassegrain Antenna. Microstrip Antenna: Basic Characteristics, Rectangular Patch, Radiation principle, Feeding Techniques, Transmission line model and cavity model.	12
MODULE 5	Antenna Measurements: Radiation Pattern, Gain and Input Impedance.	4
TEXT BOOK	1. Electromagnetic Waves and Radiating Systems, E.C.Jordan&K.G.Balmain, PHI publication Microwave Devices and Circuits, Samuel Y, Liao, Pearson Education. 2. Antennas Theory: Analysis and Design, C.A. Balanis, John Willey &Son	
REFERENCE BOOK	1. Antenna Engineering, J. D. Krauss, McGrawHill. 2. Antenna & Wave Propagation, R E. Collins, McGrawHill. 3. Antennas and Wave Propagation, G. S. N. Raju, PearsonEducation.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Demonstrate the concept of radiation through mathematicalformulation.
CO2	Evaluate performance characteristics of arrayantennas..
CO3	Implement different modes of radio wavepropagation
CO4	Analyze and design of microstrip patch antenna.
CO5	Apply basic principlesmicrowave propagation in atmosphericcondition.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2	-	-	-	-	2
CO2	3	3	3	3	3	3	2	-	-	-	-	2
CO3	3	3	3	3	2	3	2	-	-	-	-	2
CO4	3	3	3	2	2	2	2	-	-	-	-	2
CO5	3	3	3	2	1	3	1	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	3	2	3	2	-	-	-	-	2

COMPUTER COMMUNICATION & NETWORKING (BEC2702)

MODULE	CONTENT	HOURS
MODULE 1	Introduction – Data Communication, Networks, Internet, Intranet, Protocols, Network Models, Addressing. Physical Layer – Signals, Analog, Digital, Analog vs Digital, Transmission impairment, Data Rate Limits, Performance, Transmission Modes. Synchronous TDM. Transmission Media – Guided and Unguided. Switching – Circuit-Switched Networks, Datagram networks.	8
MODULE 2	Data Link Layer – Introduction, Data Link Control & Protocol – Framing, Flow & Error Control, HDLC & PPP, Multiple Access – Random (CSMA), Controlled. Wired LAN – LLC, MAC, Traditional Ethernet, Fast Ethernet, Gigabit Ethernet. Token bus, token ring Wireless LANs: IEEE 802.11, Bluetooth Connecting Devices – Repeaters, Hubs, Bridges, Two- & Three-layer Switches, Routers, Gateways, Backbone networks, Virtual circuits: Frame Relay and ATM	12
MODULE 3	Network Layer – Logical addressing, IPv4 Address, IPv6 Addresses. Network layer protocol –internetworking, IPv4, IPv6 Protocol& Packet format, IPv4 vs IPv6, Transition from IPv4 to IPv6.Address Resolution protocols.	6
MODULE 4	Transport Layer – Process to process delivery, UCP, TCP Congestion Control & Quality of Service –Data traffic, Congestion, Congestion Control, QoS and Flow Characteristics.	6
MODULE 5	Application Layer – DNS, Remote Logging (Telnet), SMTP, FTP, WWW, HTTP, SNMP.	8
TEXT BOOK	1. Data Communications and Networking (B.A. Forouzan),McGrawhill. 2. Data and Computer Communications (W.Stallings), PearsonEducation.	
REFERENCE BOOK	1. Computer Networks and Internets (D.Comer), Prentice Hall. 2. Understanding Data Communications and Networks (W.Shay),PWS.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Demonstrate the fundamental concepts of computer networking and reference models along with physical layer.
CO2	Evaluate data link layer protocols with framing, flow control and error detection techniques along with wireless LAN, V-LAN and multiple access concepts..
CO3	Implement the basic IP protocols and building the skills of subnetting and routing mechanisms
CO4	Expressthe transport layer protocols and how they can be used to assist in network design and implementation.
CO5	Analyzethe application layer protocols – DNS, Remote Logging (Telnet), SMTP, FTP, WWW, HTTP and SNMP.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	3	2	3	3	-	-	-	-	3
CO2	3	2	3	3	2	3	3	-	-	-	-	3
CO3	3	3	3	3	2	3	3	-	-	-	-	3
CO4	2	2	3	3	2	3	3	-	-	-	-	3
CO5	2	3	3	3	3	3	3	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	3	3	3	2	3	3	-	-	-	-	3

PROFESSIONAL ELECTIVE – IV

Information Theory and Coding (BECPE2705)

MODULE	CONTENT	HOURS
MODULE 1	Waveform coding: Antipodal and Orthogonal signals, Orthogonal and Biorthogonal codes, waveform coding system example, Types of error control: Terminal connectivity, automatic repeat request Structured Sequence: Channel models, Channel capacity, Channel coding, Introduction to Error correcting codes, code rate & redundancy, parity check codes: Single parity check code, Rectangular code	6
MODULE 2	Linear Block codes: vector spaces, vector subspaces, Generator matrix, systematic linear block codes, parity-check matrix, syndrome testing, error correction, Decoder implementation, Error Detecting &Correcting Capability: weight & distance of binary vectors, minimum distance of linear code, error detection & correction, erasure correction, Usefulness of Standard Array, estimating code capability, error detection vs. error correction trade-off Cyclic Codes: algebraic structures of cyclic code, binary cyclic code properties, encoding in systematic form, circuit for dividing polynomial, systematic encoding with an (n-k)-stage shift register, error detection with an (n-k)-shift register Introduction to Hamming codes, Extended Golay code, and BCH codes.	10
MODULE 3	Convolutional Encoding, Convolutional Encoder Representation: connection representation, state representation & the state diagram, the tree diagram, the trellis diagram Formulation of the Convolutional Decoding Problem: maximum likelihood decoding, channel models: hard versus soft decisions, Viterbi Convolutional Decoding Algorithm, decoder implementation, path memory and synchronization Properties of Convolutional Codes:distance properties of convolutional codes, systematic &non-systematic convolutional codes, catastrophic error propagation in convolutional codes, performance bounds for convolutional codes, coding gain, convolutional code rate trade-off, soft-decision Viterbi decoding Other Convolutional Decoding Algorithms: sequential decoding, comparisons & limitations of Viterbi &sequential decoding, feedback decoding.	10
MODULE 4	Reed-Solomon Codes: Reed-Solomon Error Probability, Why R-S codes perform well against burst noise, R-S performance as a function of size, redundancy, and code rate Interleaving & Concatenated Codes: Block interleaving, Convolutional interleaving, concatenated codes Coding & Interleaving Applied to CD Digital Audio System: CIRC encodings, CIRC decoding, interpolation & muting , turbo codeconcepts	7

MODULE 5	Modulation and Coding Trade Offs Goals of the Communications System Designer, Error Probability Plane, Nyquist Minimum Bandwidth, Shannon-Hartley Capacity Theorem, Bandwidth Efficiency Plane, Modulation and Coding Trade-Offs ,Defining, Designing, and Evaluating Digital Communication Systems, Bandwidth Efficient modulation, Modulation and Coding for Bandlimited Channels, Introduction to Trellis-Coded Modulation, Source coding and its implementation.	7
TEXT BOOK	1.Digital Communications - Fundamentals and Applications - Bernard Sklar, 2nd Edition, Pearson Education Publication. 2.Information Theory, Coding & Cryptography –RanjanBose,TMH Publication.	
REFERENCE BOOK	1.Digital Communications – Simon Haykin, Wiley Edition.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Express an understanding about the concept of waveform coding & structured sequences in relation with communicationchannel.
CO2	Evaluate the concept of linear block codes and cyclic codes for encoding and decoding of the messages for use in communicationsystem..
CO3	Evaluatethe method, structure and the process of encoding & decoding of convolutional coding. Also, students will become aware of different properties, performance bounds & trade-offs about convolutional codes with respect to communicationchannel
CO4	AnalyzeReed-Solomon& concatenated codes and their application to CD digital audiosystem.
CO5	Analyze different modulation & coding trade-offs of communicationsystems.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2	-	2	3	3	2
CO2	3	3	3	3	3	3	2	-	2	3	3	2
CO3	3	3	3	3	3	3	2	-	2	2	2	2
CO4	3	2	2	2	3	3	2	-	2	3	2	2
CO5	2	3	2	2	3	3	2	-	2	3	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	3	3	3	2	-	2	3	3	2

ADVANCED DIGITAL SIGNAL PROCESSING (BECPE702)

MODULE	CONTENT	HOURS
MODULE 1	**Multirate Digital Signal Processing:** Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by rational factor I/D, Filter design and implementation for sampling-rate conversion, Multistage implementation of sampling rate conversion, Sampling rate conversion of band pass signal, Applications of multi rate signal processing: design of phase shifters, implementation of narrowband lowpass filters, Implementation of digital filter banks, Filter bank and sub-band filters with theirapplications.	8
MODULE 2	**Discrete Time Random Process**: Introduction to random processes, Stationary & Non-Stationary random processes, statistical averages & time averages, statistical averages for joint random processes, Mean-ergodic processes & correlation-ergodic processes	8
MODULE 3	**Linear Prediction And Optimum Linear Filters:** Innovations representation of a stationary random process, Forward linear prediction, Backward linear prediction, Solution of the normal equations, Properties of the linear prediction-error filters, Wiener filter for filtering and prediction: FIR wiener filter, Orthogonality principle in linear mean squareestimation.	8
MODULE 4	**Power Spectrum Estimation:** Estimation of spectra from finite-duration observation of signals, Non parametric method for power spectrum estimation: Bartlett method, Welch method. Parametric method for power estimation: Yule-walker method, Burg method	8
MODULE 5	**Adaptive Signal Processing:** Introduction to adaptive signal processing, Applications of adaptive signal processing: system identification, channel equalization, adaptive noise cancellation, adaptive line enhancer. Adaptive Linear Combiner, Basics of Wiener filtering, Widrow-Hopf equation, Least Mean Square algorithm, Recursive Least Square algorithm	8
TEXT BOOK	1. Digital Signal Processing, Third Edition, J.G. Proakis and D.G. Manolakis, Prentice Hall. 2. Adaptive Signal Processing, B. WidrowandStern	
REFERENCE	1. Digital Signal Processing, by Sanjit K Mitra, new edition, TMH.	
BOOK	2. Digital Signal Processing, by Salivahanan, new edition, TMH.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Evaluate efficient filters for sampling rate conversion for differentapplications.
CO2	Express the significance of normal equations in linear optimum filters and techniquesused to solvethem..
CO3	Evaluate define, identify & characterize the randomsignals
CO4	Analyze and estimate the spectrum of signals from finite-duration observation ofsignals..
CO5	Implement and design adaptive filter models for different signal processingapplications.

Course Articulation Matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	3	3	2	3	3	-	-	-	-	2
CO2	3	2	3	3	2	3	3	-	-	-	-	2
CO3	3	3	3	3	2	3	3	-	-	-	-	2
CO4	2	2	3	3	2	3	3	-	-	-	-	2
CO5	2	3	3	3	3	3	3	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	2	3	3	3	2	3	3	-	-	-	-	2

Radar Engineering (BECPE703)

MODULE	CONTENT	HOURS
MODULE 1	Introduction to Radar: Basic Principle of Radar, Maximum Unambiguous Range, Radar Waveforms, Radar Block Diagram, Radar Frequencies and Applications. Radar Range Equation: Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise and SNR, Radar Cross Section of Targets (simple targets-sphere, cone-sphere)	08
MODULE 2	Doppler and MTI Radar: Doppler effect, CW Radar – Block Diagram, Applications of CW radar. Block Diagram and Characteristics of FM- CW Radar, FM-CW altimeter, Multiple Frequency CW Radar. MTI Radar Block Diagram, Blind Speeds, Double Cancellation staggered PRFs, Delay Line cancelers, Digital MTI processing, Limitations to MTI Performance, Pulse Doppler Radar.	10
MODULE 3	Tracking Radar: Principles of Tracking, Monopulse Tracking, Sequential Lobing and Conical Scan, Limitation to Tracking Accuracy, Low Angle Tracking, Automatic Tracking and surveillance Radar.	06
MODULE 4	Detection of Radar Signals in Noise: Matched Filter Receiver – Response Characteristics and Derivation, Detection criteria, Detectors, Automatic Detection, Constant False Alarm Rate receivers, Integrators and Radar Operator.	08
MODULE 5	Propagation of Radar waves: Forward Scattering, Atmospheric Refraction, Diffraction. Radar Antennas: Antenna parameters, Reflector Antennas, Phased Array Antennas- Basic Concepts, Radiation Pattern. Beam Steering, Frequency Scan Arrays. Radar Super Heterodyne Receiver.	08
TEXT BOOK	1.Introduction to Radar Systems – Merrill I. Skolnik, Second Edition, McGraw – Hill.	
REFERENCE BOOK	1. Radar Engineering and fundamentals of Navigational Aids-G.S.N.Raju,I.K International, 2008 2. Radar: Principles, Technologies, Applications- Byron Edde, PearsonEducation	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Implement basic working principle of Radar, Radar frequencies and itsapplications.
CO2	Demonstrate different types of Transmitter and Receiver ofRadar..
CO3	Analyze concept of Doppler effect and Moving Target IndicatorRadar
CO4	Express different types of Tracking Radars and the..
CO5	Implement different scanning techniques used by radars and propagationmodels.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	2	2	1	-	-	-	-	2
CO2	3	2	2	2	3	3	2	-	-	-	-	2
CO3	3	3	2	2	2	2	2	-	-	-	-	2
CO4	3	3	3	3	3	3	1	-	-	-	-	2
CO5	3	3	3	2	3	2	2	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	2	3	2	2	-	-	-	-	2

SATELLITE COMMUNICATION (BECPE2705)

MODULE	CONTENT	HOURS
MODULE 1	Introduction to Satellite Communication: Principles and architecture of satellite Communication, Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of asatellite,	8
MODULE 2	Concepts of Solar day and Sidereal day. Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.	8
MODULE 3	Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc.	8
MODULE 4	Satellite link budget Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and	8
	C/N ratio calculations in clear air and rainy conditions. .	
MODULE 5	Modulation and Multiple Access Schemes: Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA	8
TEXT BOOK	1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition2002 2. Dennis Roddy: Satellite Communication: 4th Edition, McGrawHill,2009	
REFERENCE BOOK	1. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Implement the fundamentals of orbital mechanism, the characteristics of common orbits and launch methods and technologies in satellitesystems.
CO2	Analyze the typical phenomena in satellite communication and its corresponding effects in design of satellite link and able to specify the possible remedies to overcome the problems
CO3	Express the different sub-systems of a typical satellite communicationsystem
CO4	Implement satellite link budget for a desired C/Nratio.
CO5	Analyze and implement modulation and multiple access schemes for a satellitelink.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	3	1	-	-	-	-	3
CO2	3	3	3	2	3	3	2	-	-	-	-	3
CO3	2	2	3	3	2	2	1	-	-	-	-	3
CO4	2	2	3	2	3	3	2	-	-	-	-	3
CO5	3	3	3	3	3	2	2	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	3	3	3	3	2	-	-	-	-	3

SESSIONAL

ADVANCED COMMUNICATION LAB (BEC2793)

Experiment No.	CONTENT
1	Study and analysis of direct sequence and frequency hopping spread spectrum communication system.
2	Design the wireless communication system using ISDN, GSM, GPRS and MPLS system.
3	Study and analysis of OFDM-based transceiver using the Ettus B210 software defined radio
4	Study and analysis of cognitive trans-receiver.
5	Study and simulation of distance vector routing and Link state routing.
6	Generation of digital signals, and perform pulse-shaping, synchronization, and equalization for different digital modulation schemes using USRP B-210 and GNUradio
7	Simulation of adaptive MIMO system with orthogonal space-time block code using MATLAB
8	Study and analysis of transmit and receive diversity in MIMO using MATLAB
9	Study and analysis of F-OFDM,UFMC and FBMC modulation scheme at both transmit and receive ends of a communication system using MATLAB
10	Establish the optical fiber link and measure numerical aperture, attenuation and bendingLoss.
11	Setting up a link to transmit and receive three separate signals (Audio, video, tone) through satellite link.
12	Simulation of real traffic parameter using OpenStreetMap and SUMO.

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Implement the main concepts, techniques and performance criteria used in the analysis and design of advance communicationsystem.
CO2	Analyze the wireless communication system using ISDN, GSM, GPRS and MPLSsystem
CO3	Analyse, design and evaluate OFDM-basedtransceiver
CO4	Express the relevance of fundamental issues regarding dynamic spectrum access and radio-resourcemanagement.
CO5	Implement the universal software defined radio for generation and analysis of various real timesignals.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	2	1	-	-	-	-	3
CO2	2	3	3	2	2	3	2	-	-	-	-	2
CO3	3	2	3	3	3	2	2	-	-	-	-	3
CO4	3	2	3	2	2	3	2	-	-	-	-	3
CO5	3	3	3	3	3	2	2	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	3	2	3	2	2	-	-	-	-	3

EIGHTH SEMESER

PROFESSIONAL ELECTIVE – V

ADVANCED COMMUNICATION SYSTEM (BEC2809)

MODULE	CONTENT	HOURS
MODULE 1	Introduction to Spread Spectrum Modulation: Introduction, direct sequence spread spectrum, frequency hopping multiple access, CDMA, cellular CDMA systems, multi user detection, time hopping impulse radio.	8
MODULE 2	Principle of OFDM, implementation of transceivers, frequency-selective channels, channel estimation, peak to average power ratio, inter carrier interference, adaptive modulation and capacity, multiple access. Universal Filtered Multi-Carrier(UFMC), Filtered-OFDM (F-OFDM) , Filter Bank Multi-Carrier (FBMC) system	8
MODULE 3	Multi antenna system: smart antennas, multiple input multiple output systems, multi user MIMO. Spatialmultiplexing,orthogonal space-time block codes (OSTBC) encoder/decoder.	8
MODULE 4	Cognitive transceiver architecture, principle of interweaving, spectrum sensing, spectrum management, spectrum sharing, overlay and underlay network.	8
MODULE 5	Fundamentals of relaying, relaying with multiple parallel relays, routing and resource allocation in multi hop networks, routing and resource allocation in collaborative networks, applications, network coding.	8
TEXT BOOK	. 1..Molisch: Wireless Communications, Wiley India. 2. UpenaDalal: Wireless Communications, Oxford University Press.	
REFERENCE BOOK	1. KamiloFeher: Wireless Digital Communications, PHILearning. 2. Zeimer, Peterson and Borth: Introduction to Spread Spectrum Communication, PearsonEducation. 3. Mullet: Introduction to Wireless Telecommunication Systems andNetworks, Cengage Learning.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze compare and contrast between the different spread spectrum communication systems
CO2	Evaluate the performance characteristics ofOFDM
CO3	Analyse, design and evaluate OFDM-basedtransceiver
CO4	Implement digital encoders and decoders for multi antennasystem.
CO5	Analyze and apply routing and resource allocation in collaborativenetwork.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1	2	2	3	-	-	-	-	3
CO2	3	3	3	2	2	3	1	-	-	-	-	3
CO3	2	3	2	1	1	2	2	-	-	-	-	3
CO4	3	2	3	2	3	3	2	-	-	-	-	3
CO5	2	3	2	3	2	3	3	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	3	3	2	2	3	2	-	-	-	-	3

Antenna Analysis and Synthesis (BECPE802)

MODULE	CONTENT	HOURS
MODULE 1	Analysis of dipoles: Infinitesimal Dipole, Small Dipole, Region Separation, Finite Length Dipole, Half Wavelength Dipole, Brief Discussion on Linear Elements Near or on Infinite Conductors	08
MODULE 2	Analysis of linear array: Two-Element Array, Uniform Amplitude and Spacing *N*-Element Linear Array, Broadside Array, Ordinary End-Fire Array, Phased (Scanning) Array, Hansen-Woodyard End-Fire Array,Directivity of all the *N*-Element Linear Arrays, Three-Dimensional Characteristics of*N*-Element Linear Array, Uniform Spacing and Non-uniformAmplitude*N*-Element Linear Array, Binomial Array, Dolph-TschebyscheffArray	10
MODULE 3	Analysis of planar array: Array Factor, Beamwidth, Directivity, Design Considerations, Circular Array	06
MODULE 4	Synthesis of array based on Null Control: Schelkunoff Polynomial Method. Synthesis of array based on Low Sidelobes: Taylor Line-Source (Tschebyscheff-Error), Taylor Line-Source (One-Parameter)	08
MODULE 5	Synthesis of array based on Shaped Beam: Fourier Transform Method, Woodward-LawsonMethod, Triangular, Cosine, and Cosine-Squared Amplitude Distributions, Line-Source Phase Distributions, Continuous ApertureSources	08
TEXT BOOK	1.Antenna Theory: Analysis and Design, 3rdEdn., by C. A. Balanis, John Wiley & Sons, New York.	
REFERENCE BOOK	1. Antenna Synthesis, Theory and Practice, by H. J.Shaw 2. Antennas and Wave Propagation ,4th Edn., by R. J.Marhefka, A. Khan, J. D. Kraus,TMH	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze a singledipole
CO2	Evaluate and analysis of a group of dipole elements present at same time along a singleaxis.
CO3	Express the analysis of a group of dipole elements present at same time on asurface
CO4	Implement synthesis of array based on null control and lowsidelobes.
CO5	Analyze the synthesis of array based on beamshaping.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	2	1	-	-	-	-	2
CO2	3	3	3	2	3	2	2	-	-	-	-	2
CO3	2	2	3	3	2	2	1	-	-	-	-	2
CO4	2	2	3	2	3	3	2	-	-	-	-	2
CO5	3	3	3	3	3	2	2	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	2	3	3	3	2	2	-	-	-	-	2

ADVANCED ANTENNA TECHNOLOGY (BEC2809)

MODULE	CONTENT	HOURS
MODULE 1	Biconical antenna, Discone and conical skirt monopole, theory behind frequency independent antenna, equiangular spiral antenna, fractal antenna concept and technology, corrugated horn antenna, multimode hornantenna.	08
MODULE 2	Smart antenna systems, benefit, drawbacks of Smart antenna, array design for smart antennas, adaptive beamforming, MANET, array theory, Electrically & Physically small & big antenna	08
MODULE 3	Artificial dielectric lens antenna, Luneburg & Einstein lenses, electrically and small antenna, ground plane antenna, sleeve antenna, turnstile antenna, submerged antenna, surface wave and leaky wave antenna, weather-vane antenna, flagpole antenna, chimney antenna, ILS antenna, sugar-scoop antenna, asteroid detection antenna, embedded antenna, plasma antenna	08
MODULE 4	Microstrip and other planar antennas, Various types of feeding methods for microstrip antenna (Co-axial, Inset, Aperture/Slot Coupled, Proximity coupled and Corporate feeding for Arrays); Analysis of rectangular Patch Antenna, Cavity/ Modal Expansion Technique, microstrip antenna array	10
MODULE 5	Conventional Scanning Techniques, Feed Networks for phased Arrays, Frequency Scanned Array Design, Target indicators, Search Patterns	06
TEXT BOOK	1. Antennas Theory – Analysis and Design, By C. Balanis, Wiley IndiaEdition 2. Antennas, By J. D. Kraus & others, McGraw Hill-Special IndianEdition	
REFERENCE BOOK	1. Phased Array Antennas, By A. A. Ollinerand G.H. Knittel,ArtechHouse 2. Introduction to Radar Systems, By M. L. Skolnik, McGrawHill	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Demonstrate different design and operation of broadband antennas including comparison ofitsassociatedparameters
CO2	Evaluate different design and operation of Smart antennas including associatednetworks.
CO3	Express several advanced antennas for specialapplication
CO4	Implement different design and operation of different types of patch antennas andtheir feedings.
CO5	Express different scanningtechniques.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	-	-	-	-	-	-	3
CO2	3	3	2	2	2	-	-	-	-	-	-	3
CO3	3	3	2	2	2	-	-	-	-	-	-	3
CO4	3	3	2	2	3	-	-	-	-	-	-	2
CO5	3	3	2	2	3	-	-	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	2	2	2	-	-	-	-	-	-	3

Smart Antennas (BECPE804)

MODULE	CONTENT	HOURS
MODULE 1	Brief discussion on some recent antennas and its parameters: Wideband, multiband, phased array, adaptive array, highly directional, low profile, low side-lobes, low back-lobe, low beam-width, high SNR, lowloss	06
MODULE 2	Fundamentals on Smart antennas: Need of Smart antennas, Smart antenna configurations, Space division multiple access (SDMA), Architecture of Smart antenna system, Benefits and drawbacks, Basic principles, Mutual coupling effects System design and requirements: Fixed beam systems, switched beam systems, adaptive antenna system, calibration	08
MODULE 3	DOA algorithms and application: Conventional methods, sub-space methods, Integrated methods. Other methods, DOA estimation under coherent signal conditions, DOA estimation under other conditions	08
MODULE 4	Beamforming fundamentals: The classical beam-former, Statistically Optimum Beamforming weight vectors, Adaptive algorithms for beamforming	08
MODULE 5	Integration and simulation of Smart antennas: Antenna design, mutual coupling, Adaptive signal processing algorithms, Trellis coded modulation for adaptive arrays, smart antenna systems for Mobile Ad-Hocnetworks	10
TEXT BOOK	1. Smart Antennas for Wireless Communications IS-95 and Third Generation CDMA Applications, By J. C. Liberti Jr., T. S Rappaport, PTR – PH publishers 2. Smart Antennas, By Lal Chand Godara, CRCPress	
REFERENCE BOOK	1. Introduction to Smart Antennas by C. A. Balanis and P. I. Ioannides, Morgan &ClaypoolPublishers 2. Smart Antennas Adaptive Arrays Algorithms and Wireless Position Location, By T.S. Rappaport , IEEEPress, PTR – PHpublishers	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Express basic working principle of recentantennas
CO2	Evaluate foundation of smartantennas.
CO3	Analyze different types of Directional of Arrivalalgorithms
CO4	Implement different types of beamformingtechniques.
CO5	Demonstrateworking principle of practical smartantenna.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	2	1	-	-	-	-	2
CO2	2	3	3	2	2	2	2	-	-	-	-	2
CO3	2	3	3	2	2	2	2	-	-	-	-	2
CO4	3	2	3	2	2	2	2	-	-	-	-	2
CO5	3	3	3	3	3	2	2	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	2	2	2	2	-	-	-	-	2

EMBEDDED SYSTEMS (BECPE805)

MODULE	CONTENT	HOURS
MODULE 1	Introduction and Modeling: Introduction to Embedded Systems Design Flow, Formal specification and Modeling Strategies – I, Formal specification and Modeling Strategies – II, Hardware-Software Co-Design principles and details of hardware design: Hardware Software Co-Design, Architectural Design of Hardware – I, Architectural Design of Hardware - II	8
MODULE 2	Introduction to Scheduling in embedded systems: System and Task level Timing Analysis, Uni-processor Real-time Scheduling, Multiprocessor Real-time Scheduling, Resource Allocation Strategies in Automotive Systems, Energy-aware and Fault-tolerant Real-time Scheduling	8
MODULE 3	Introduction to Formal Verification: Introduction and Basic Operations on Temporal Logic, Syntax and Semantics of CTL, Equivalence between CTL Formulas, Model Checking Algorithm Embedded System Verification for Embedded Systems: Software Verification, Verification of real time systems hardware Testing	8
MODULE 4	Test: Introduction to Digital VLSI Testing, Automatic Test Pattern Generation (ATPG), Scan Chain based Sequential Circuit Testing Embedded System hardware Testing: Software-Hardware Co-validation Fault Models and High Level Testing for Complex Embedded Systems, Testing for embedded cores, Bus and Memory Testing	8
MODULE 5	Advances in Embedded System hardware Testing: Testing for advanced faults in Real time Embedded Systems, BIST for Embedded Systems, Concurrent Testing for Fault tolerant Embedded Systems, Testing for Embedded Software Systems, Interaction Testing between Hardware and Software, Software testing for Reprogrammablehardware	8
TEXT BOOK	1. Marwedel, P. (2006). *Embedded system design* (Vol. 1). New York:Springer. 2. Wolf, M. (2012). *Computers as components: principles of embedded computing system design*.Elsevier. 3. Roychoudhury, A. (2009). *Embedded systems and software validation*. MorganKaufmann.	
REFERENCE BOOK	1. Huth, M., & Ryan, M. (2004). *Logic in Computer Science: Modellingand reasoning about systems*. Cambridge universitypress. 2. Bushnell, M., &Agrawal, V. (2004). *Essentials of electronic testing for digital, memory and mixed-signal VLSI circuits* (Vol. 17). Springer Science&BusinessMedia.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Express the differences between the general computing system and the embedded system, also recognize the classification of embeddedsystems
CO2	Evaluate the general process of embedded system development.
CO3	Analyze what an embedded system R&D project is, and the activities involves
CO4	Apply basic principles peripherals, knowledge of typical interfacingstandards
CO5	DemonstrateRT UML for system level, hardware, and software modeling, used to: refineconcepts, produce system designs, and express ideas.

Course Articulation Matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	2	3	2	1	-	-	-	-	2
CO2	2	3	3	2	2	3	2	-	-	-	-	2
CO3	3	2	3	3	3	2	2	-	-	-	-	2
CO4	3	2	3	2	2	3	2	-	-	-	-	2
CO5	3	3	3	3	3	2	2	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO	3	2	3	2	3	1	2	-	-	-	-	2

IC For Broadband Communication (BECPE806)

MODULE	CONTENT	HOURS
MODULE 1	Evolution toward Broadband:- Overview, Drivers for Broadband-Semiconductor Technology, Fibre Optics, Computing Technology, Applications-LAN Interconnect, CAD/CAE/CAM, Visualization, Imaging, Supercomputing & Channel Extension, Multimedia, Internet Access, Standards.	4
MODULE 2	Digital signal transmission, Drivers and receivers for low frequencies; Serialization and Deserialization, Digital signal transmission over lossy and dispersive channels: Eye diagrams; Eye closure; crosstalk, and jitter;	9
MODULE 3	Equalization: Transmit pre-emphasis, Linear and non-linear equalizers Receive feed-forward equalization, and decision feedback equalization	9
MODULE 4	Integrated circuit implementation of broadband amplifiers for transmission and reception, feed-forward and decision feedback equalization.	9
MODULE 5	Synchronization: clock and data recovery circuits using phase locked loops and delay locked loops. multiplexers, and demultiplexers.	9
TEXT BOOK	1. David Johns and Ken Martin, Analog Integrated Circuit Design, John Wiley &Sons, 1997. 2. Y. Tsividis, Mixed Analog Digital VLSI Devices and Technology (Anintroduction), World Scientific,2002. 3. Broadband Communications, Balaji Kumar, Mac-GrawHillpublications.	
REFERENCE BOOK	1.BehzadRazavi, Design of Analog CMOS Integrated Circuits, McGraw-Hill, 2000. 2.K. R. Laker and W.M.C. Sansen, Design of Analog Integrated Circuits and Systems, McGraw-Hill, 1994. 3.William J. Dally, John W. Poulton, Digital Systems Engineering, Cambridge University Press, 1998.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Express the broadband communication area and its scope
CO2	Evaluate important concepts of digital signal transmission, eye diagrams, crosstalk etc..
CO3	Apply basic various equalization circuits and their IC implementation
CO4	Analyze the IC implementation of broadband amplifiers for transmission & reception.
CO5	Demonstrate an understanding about various synchronizationcircuits.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1	2	2	3	-	-	-	-	2
CO2	3	3	3	2	2	1	1	-	-	-	-	2
CO3	2	3	2	1	1	2	2	-	-	-	-	2
CO4	2	2	3	2	3	1	2	-	-	-	-	2
CO5	3	3	2	3	2	2	3	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	3	3	2	2	2	2	-	-	-	-	2

DSP ARCHITECTURES (BECPE807)

MODULE	CONTENTS	HOURS
MODULE 1	***Introduction***: A Digital Signal-Processing System, Analysis and Design Tool for DSP Systems, ***Computational Accuracy in DSP Implementations***: Number Formats for Signals and Coefficients in DSP Systems, Dynamic Range and Precision, Sources of Error in DSP Implementations-A/D Conversion Errors, DSP Computational Errors, D/A Conversion Errors	08
MODULE 2	***Architecture for Programmable DSP Devices***: Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Module, Programmability and Program Execution, Execution Control-Hardware Looping, Interrupts, Stacks, Relative Branch Support, Speed Issues, Pipelining-Pipelining and Performance, Pipeline Depth, Interlocking, Branching Effects, Interrupt Effects, Pipeline Programming Models. Features for ExternalInterfacing	08
MODULE 3	***Programmable Digital Signal Processors***: Commercial Digital Signal-Processing Devices, The Architecture of TMS320C54XX Processors, Data Addressing Modes of TMS320C54XX Processors, Memory Space of TMS320C54XX Processors, Program Control, TMS320C54XX Instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX Processors, Pipeline Operation of TMS320C54XX Processors.	08
MODULE 4	***Implementation of DSP Algorithms***: -The Q-Notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, An FFT Algorithm for DFT Computation, A Butterfly Computation-Overflow and Scaling, Bit-Reversed Index Generation, An 8-Point FFT Implementation on The TMS320C54XX, Computation of the Signal Spectrum.	08
MODULE 5	***Interfacing Memory and Peripherals to DSP Processor***: -Memory Space Organization, External Bus Interfacing Signals, Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O, Direct Memory Access (DMA). A Multichannel Buffered SerialPort	08

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Express A Digital Signal-Processing System
CO2	Analyze Architecture for Programmable DSP Devices.
CO3	Apply basic principle of Programmable Digital Signal Processors
CO4	Implement of DSP Algorithms.
CO5	Demonstrate Interfacing Memory and Peripherals to DSP Processor.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1	2	2	3	-	-	-	-	2
CO2	3	3	3	2	2	1	1	-	-	-	-	2
CO3	2	3	2	1	1	2	2	-	-	-	-	2
CO4	2	2	3	2	3	1	2	-	-	-	-	2
CO5	3	3	2	3	2	2	3	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	3	3	2	2	2	2	-	-	-	-	2

OPEN ELECTIVE

MEMS(3-1-0) (BECOE601)

MODULE	CONTENT	HOURS
MODULE 1	Introduction to MEMS: Historical Background, Scaling Effects. Micro/Nano Sensors, Actuators and Systems overview, Materials and Substrates for MEMS, Sensors characterization and classifications, microactuators, Application of MEMS.	10
MODULE 2	MEMS fabrication methods: Oxidation, Deposition Techniques, Lithography (LIGA), and Etching. Micromachining: Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding.	8
MODULE 3	Mechanics of solids in MEMS, Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending, Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.	8
MODULE 4	MEMS Types: Mechanical MEMS, Strain and pressure sensors, Accelerometers etc., Electromagnetic MEMS, Micromotors, Wireless and GPS MEMS etc Magnetic MEMS, all effect sensors, SQUID magnetometers, Optical MEMS, Micromachined fiber optic component, Optical sensors.	8
MODULE 5	MEMS Applications: Optical: Micro-lens, Micro-mirror, Optical switch. Radio frequency MEMS: Inductor, Varactor, Filter, Resonator. Thermal MEMS: thermo-mechanical and thermos electrical actuators.	6
TEXT BOOK	1. G.K. Ananthsuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Atre: Micro and Smart Systems, Wiley India, New Delhi,2010. 2. N.P. Mahalik: MEMS, Tata McGraw-Hill, New Delhi,2007.	
REFERENCE BOOK	1. T. Hsu: MEMS and Microsystems: Design and Manufacture, Tata McGraw-Hill, New Delhi,2002. 2. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001. 4. M. Madou, Fundamentals of Microfabrication, CRC Press,1997. 3. R.S. Muller, Howe, Senturia and Smith, "Microsensors", IEEEPress. 4. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano- and Microengineering, Vol. 8, CRC press,(2005).	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze the underlying working principles of MEMS devices
CO2	Demonstratethe various MEMS fabrication methods for various types of MEMSdevices
CO3	Express numerical problems of Mechanics of solids by using different computationalmethods.
CO4	Implement the design, analysis & testing of different MEMS Typedevices.
CO5	Demonstratethe MEMS technology for differentapplications.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1	2	2	3	-	-	-	-	2
CO2	3	3	3	2	2	1	1	-	-	-	-	2
CO3	2	3	2	1	1	2	2	-	-	-	-	2
CO4	2	2	3	2	3	1	2	-	-	-	-	2
CO5	3	3	2	3	2	2	3	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	3	3	2	2	2	2	-	-	-	-	2

MICROPROCESSORS (BECOE501)

MODULE	CONTENT	HOURS
MODULE 1	Introduction of Microcomputer System: CPU, I/O devices, clock, memory, bussed architecture, tristate logic, address bus, data bus and control bus. Semiconductor Memories: Development of semiconductor memory, internal structure and decoding, memory read and write timing diagrams, MROM, ROM,EPROM,EEPROM, DRAM.	8
MODULE 2	Architecture of 8-bit Microprocessor: Intel 8085A microprocessor, Pin description and internal architecture. Operation and Control of Microprocessor: Timing and control unit, op-code fetch machine cycle, memory read/write machine cycles, I/O read/write machine cycles, interrupt acknowledge machine cycle, state transitiondiagram	8
MODULE 3	Instruction Set: Addressing modes; Data transfer, arithmetic, logical, branch, stack and machine control groups of instruction set, macro RTL and micro RTL flow chart of few typical instructions; Unspecified flags and instructions. Assembly Language Programming: Assembler directives, simple examples; Subroutines, parameter passing to subroutines.	8
MODULE 4	Interfacing: Interfacing of memory chips, address allocation technique and decoding; Interfacing of I/O devices, LEDs and toggle-switches as examples, memory mapped and isolated I/O structure; Input/Output techniques: CPU initiated unconditional and conditional I/O transfer, device initiated interrupt I/O transfer. Interrupts: Interrupt structure of 8085A microprocessor, processing of vectored and non-vectored interrupts, latency time and response time; Handling multipleinterrupts	8
MODULE 5	Programmable Peripheral Interface: Intel 8255, pin configuration, internal structure of a port bit, modes of operation, bit SET/RESET feature, programming;ADC and DAC chips and their interfacing. Programmable Interval Timer: Intel 8253, pin configuration, internal block diagram of counter and modes of operation, counter read methods, programming, READ-BACK command of Intel 8254.	8
TEXT BOOK	1. Hall D.V.,"Microprocessor and Interfacing-Programming and Hardware", 2nd Ed., Tata McGraw-Hill Publishing Company Limited,2008. 2. Stewart J,"Microprocessor Systems- Hardware,Software and Programming", Prentice Hall InternationalEdition,1990 3. GaonkarR.S.,"MicroprocessorArchitecture,Programming and Applications", 5th Ed., Penram International,2007.	
REFERENCE BOOK	1. Short K. L.,"Microprocessors and Programmed Logic", 2nd Ed.,Pearson Education, 2008. 2. Intel Microprocessors: Architecture, Programming and Interfacing by Barry B.Bray,PHI.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze and solve basic binary math operations using the microprocessor and explain the microprocessor's internal architecture and its operation within the area of manufacturing and performance
CO2	Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the targetmicroprocessor
CO3	Expressand compare accepted standards and guidelines to select appropriate Microprocessor to meet specified performance requirements..
CO4	Analyze assembly language programs; select appropriate assemble into machine a cross assembler utility of amicroprocessor
CO5	Demonstrateelectrical circuitry to the Microprocessor I/O ports in order to interface the processor to externaldevices.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	2	-	-	-	-	2
CO2	3	3	3	3	3	2	2	-	-	-	-	2
CO3	3	3	3	3	2	2	2	-	-	-	-	2
CO4	3	3	3	2	2	2	2	-	-	-	-	2
CO5	3	3	3	2	1	2	1	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	3	2	2	2	-	-	-	-	2

VLSI Engineering (BECOE502)

MODULE	CONTENT	HOURS
MODULE 1	Introduction to VLSI Systems: Introduction to IC Technology, VLSI Design methodology, Design domains-Y chart, Hierarchical Abstraction, VLSI Design flow, VLSI Design styles, CAD tools for VLSI Design, NMOS and CMOS Fabrication Process, Design rules	6
MODULE 2	MOS Transistor: The Metal Oxide Semiconductor (MOS) structure, The MOS system under external bias, structure and operation of MOS transistor, MOSFET Scaling ,MOSFETCapacitances MOS Inverter Static Characteristics: Introduction, Resistive load inverter, CMOS inverter MOS Inverter dynamic Characteristics: Introduction, Delay time definitions, calculation of Delay times, Inverter design with delay constraints, Calculation of interconnect delay, Switching power dissipation of CMOS inverters	10
MODULE 3	Digital CMOS Logic Design: Digital logic gates Design, Combinational logic circuits, Flip-flops (SR, JK, D,T), Pseudo-nMOS logic, CMOS Transmission gate, Dynamic CMOS logic circuit, Domino CMOS logic, NORA CMOS logic, Zipper CMOS logic, Pass Transistor logic, Complimentary Pass Transistor logic, Differential CMOS Logic, Adiabatic logic, Semiconductor memories	8
MODULE 4	Timing Analysis: Introduction, Delay in VLSI circuits, Delay in CMOS inverter, Slew Balancing, Transistor Equivalency, Effect of Transistor size on propagation delay, design of logic gates for Equal Rise and Fall Slew. Inverter sizing effect on Propagation delay, LogicalEffort Physical Design: Introduction, Floorplanning, Placement, Routing BiCMOS Technology: BiCMOS Technology, BiCMOS logic circuits, BiCMOS Two–input NAND logic, Complex Logic using BiCMOS.	8
MODULE 5	VLSI Testing: Introduction, Fault Models, Fault simulation, Design for Testability, Ad Hoc Testing, Scan Test, Built In Self Test (BIST), IDDQ test, Yield. Digital Design using Verilog: Introduction, Verilog Naming Conventions, Operators in Verilog, Verilog Data types, BehaviouralModelling, Structural Modelling, Combinational and Sequential Logic in Verilog	8
TEXT BOOK	1. Kang, S. M., &Leblebici, Y. (2003). *CMOS digital integrated circuits*. Tata McGraw-Hill Education. 2. Das, D. (2015). *VLSI design*. Oxford UniversityPress.	
REFERENCE BOOK	1. Weste, N. H., & Harris, D. (2015). *CMOS VLSI design: a circuits and systems perspective*. Pearson EducationIndia. 2. Rabaey, J. M., Chandrakasan, A. P., &Nikolic, B. (2002). *Digital integrated circuits* :Prenticehall. 3. Palnitkar, S. (2003). *Verilog HDL: a guide to digital design and synthesis*. Pearson Education India.	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Demonstrate a clear understanding of CMOS fabrication flow and technologyscaling
CO2	Express CMOS based logic circuit
CO3	Implement logic circuits with different design styles
CO4	Demonstrate an understanding of working principles of clocking, power reductionand distribution of VLSICircuits
CO5	Evaluate the basics of Fabrication and Layout of CMOS IntegratedCircuits.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	2	-	-	-	-	3
CO2	3	3	3	3	3	2	2	-	-	-	-	3
CO3	3	3	3	3	2	2	2	-	-	-	-	3
CO4	3	3	3	2	2	2	2	-	-	-	-	3
CO5	3	3	3	2	1	2	1	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	3	2	2	2	-	-	-	-	3

Image Processing (BECOE701)

MODULE	CONTENT	HOURS
MODULE 1	**Unit I**: (08 Hrs) Origins of digital image processing, Various Imaging techniques, components of an image processing system, Image sensing and acquisition, Image sampling and quantization, neighbours of a pixel, Adjacency, Connectivity, Regions and boundaries.	6
MODULE 2	**Unit II**: (08 Hrs) Basic intensity transformation and spatial filtering, Image negatives, log transforms, power- law transformations, median filtering, Histogram equalization, Histogram matching spatial correlation and convolutions. Two-dimensional orthogonal and Unitary Transforms, properties of Unitary transforms 2DDFT, Cosine transforms, Sine transforms, Hadamard transform, Haar transforms, Slant transforms.	10
MODULE 3	**Unit III**: (07 Hrs) Model of image Degradation/Restorations process, Noise models, Restoration in the presence of noise only, periodic noise reduction by Frequency domain filtering, Image reconstruction from Projections, Image compression models, Huffman coding, LZW coding, Run length coding, Bit-plane coding.	8
MODULE 4	**Unit IV**: (07 Hrs) Some basic morphological algorithms, Boundary extraction, convex hull, thinning, skeletons, morphological Reconstruction. Colour image processing, colour models, RGB colour models, CMY and CMYK colour models the HSI colour models.	8
MODULE 5	**Unit V**: (07 Hrs) Image segmentation, Fundamentals, Point, Line and edge detection, of segmentation, Thresholding, Region-based segmentation, watershed segmentation algorithm Applications of segmentation, Hyperspectral image processing, latest development in digital image processing.	8
TEXT BOOK	1. Rafael C. Gonzalez, Richard E. Woods, Digital image processing, 3rd Edition, Pearson PHI Publication,2007 2. A K. Jain, Fundamental of Digital Image Processing, 4th edition, PHI Publication.1989 3. S. Jayaraman, S. Esakkirajan, T. Virakumar, Digital image processing, 1st edition, McGraw Hill,2011	

REFERENCE BOOK	1. J.C. Russ, The Image Processing Handbook, 5th Edition, CRC,2006 2. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Digital Image Processing Using MATLAB, 2nd edition, Pearson PHI Publication,2009

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Demonstrate the fundamentals of the human visual system and perception with knowledge of imaging systems and processing units
CO2	Express spatial filtering techniques and image enhancement algorithms
CO3	Implement 2D Fourier transform concepts, and other transforms (DCT, Haar, WHT) and their use in frequency domain filtering
CO4	Demonstrate degradation problem in digital image processing and to understand the principles of image compression
CO5	Evaluate employ morphological filtering techniques to clean up and cluster image for further analysisand apply these techniques to solve real-world image processing problems.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	3	2	-	-	-	-	3
CO2	3	3	1	2	3	3	2	-	-	-	-	3
CO3	3	3	1	2	3	2	2	-	-	-	-	3
CO4	3	3	2	2	3	2	2	-	-	-	-	3
CO5	3	3	2	2	3	3	3	-	-	-	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	2	2	3	3	2	-	-	-	-	3

Digital Voice and Picture Communication(BECOE702)

MODULE	CONTENT	HOURS
MODULE 1	Introduction, Speech Production Model, Speech Coding: Objectives and Requirements, Quantizers for Speech Signal, Mew - Law and Optimum Quantizer, Adaptive Quantizer,Differential Quantization, LDM and ADM.	6
MODULE 2	Differential PCM and Adaptive Prediction,Linear Prediction of Speech,Computational Aspects of LPC parameters,CholeskyDecomposition,Lattice Formulation of LPC Coefficient,Linear Predictive Synthesizer,LPCVocoder.	10
MODULE 3	Introduction to Image and Video Coding, Lossy Image Compression: DCT, DCT Quantization and Limitations,Theory of wavelets, Discrete wavelet transform, DWT on images and its encoding, embedded zero tree wavelet encoding	8
MODULE 4	Video coding-basic building blocks, motion estimate techniques, fast motion estimate techniques, video coding standards, advanced coding aspects, audio coding-basic concepts, audio coding-AC-3, AC-3 decoder.	8
MODULE 5	MPEG - 1 Audio Coding,Introduction to VoIP, VoIP Signaling: H.323 Protocol, H.323 Call Controls and Enhancements, Interworking with PSTN Limitations and Solution,Multiplexing Schemes, H.323:Multiplexing:Header Compression and BW, ISDN Video Conferencing, Video Conferencing: SIP Protocol,4G Multimedia Conferencing.	8
TEXT BOOK	1. "Principles of Digital Audio, Sixth Edition (Electronics)" by Ken CPohlmann. 2. "Digital Pictures: Representation and Compression (Applications of Communications Theory)" by ArunNetravali. 3. "Digital Media Worlds: The New Economy of Media" by Giuditta De Prato and Jean PaulSimon	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze the speech production model.
CO2	Analyze the linear predictive coding and synthesizing
CO3	Implement audio and video coding procedures
CO4	Demonstrate compression techniques on audio and video
CO5	Evaluate video conferencing standards.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	2	-	-	-	-	2
CO2	3	3	3	3	1	2	2	-	-	-	-	2
CO3	3	3	2	3	2	2	2	-	-	-	-	2
CO4	3	3	2	3	2	2	2	-	-	-	-	2
CO5	3	3	2	2	1	2	2	-	-	-	-	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	2	3	2	2	2	-	-	-	-	2

Audio &Video Systems (BECOE801)

MODULE	CONTENT	HOURS
MODULE 1	Characteristics of Sound: Nature of Sound, Pressure and Intensity of sound waves, Sensitivity of human ear for sound, Frequency of sound waves, Overtones and timbre, Intervals octaves and harmonics, Pitch, Resonance effect in sound systems, Helmholtz resonator, Reflection and diffraction of sound waves.Audio devices and their applications: Microphones, Loudspeakers.	6
MODULE 2	Loudspeaker column or line source speakers, Baffles and Enclosures, Multi-way Speaker System (Woofers and Tweeters), Consequence of Mismatch between Amplifier Output and Loudspeaker Impedance. Optical recording: Types of Optical Recording of sound, Methods of Optical Recording of Sound on Film, Reproduction of Sound from Films, Modern method of recording of sound for movie films, Compact Disc, Optical recording on Disc, Playback process, Comparison of Compact Discs and Conventional(Gramophone) Discs. Introduction to Blue ray technology, Introduction to High Fidelity(Hi- fi) systems, Introduction to Public Address Systems(PA-Systems), Introduction to Audio Amplifiers, Introduction to Acoustic Reverberation, Introduction to AM/FM tuners, Introduction to USB Mp3 players.	10
MODULE 3	Television Fundamentals: Elements of TV communication system, Scanning, Synchronization, Aspect ratio, Pixels, Resolution, Bandwidth, Composite video signal, Modulation of video and audio signals, Monochrome and color cameras, Compatibility, Luminance and Chrominance signal, Picture tubes, Solid state picture transducers, TV broadcasting systems, Video monitors.Digital Television-Transmission and Reception: Digital system hardware, Signal quantizing and encoding, digital satellite television, Direct-To-Home(DTH) satellite television, Digital TV receiver, Merits of digital TV receivers, Digital Terrestrial Television(DTT), Introduction to Video on demand, Introduction to CCTV, Introduction to CATV.	8
MODULE 4	Stereophonic sound, Flat panel TV receivers, 3-Dimensional TV, EDTV, HDTV and Digital Studio equipments: Stereo sound systems, Projection television, Flat panel display TV receivers, Three Dimensional (3-D) television, Advances in 3D TV technology, Present status of new 3D receivers, Extended Definition Television(EDTV), Digital equipment for television studios, Electronic control of studio lights, Digital audio recorders and editing, Colour receivers of new generation, Liquid Crystal and Plasma Screen Televisions: LCD technology, LCD matrix types and operation, LCD screens for television, Plasma and conduction of charge, Plasma television screens, Signal processing in Plasma TV receivers, A Plasma colour receiver, LCD colour receivers, Single LCD receivers, 3-LCD colour receivers, Plasma or LCD-which is the best choice, Performance comparison of Plasma and LCD televisions, Introduction to LED TV, RGB dynamic LEDs, Edge-LEDs, Differences between LED-backlit and Backlit LCD displays, Comparison of Plasma TV and LED TV, Introduction to OLED TVs.	8

MODULE 5	Projection Display Systems and Television Home Theatres: Direct View and rear projection systems, front projection TV system, Transmittive type projection systems, Reflective projection systems, Digital Light Processing(DLP) projection system, Projection television for home theatres, Choice of projection TV system, Essential features of front projectors, Comparison and choice of rear projection receivers, Satellite Off-Air tuners and Digital Video Recorders, Surround sound stereo receiver, Top of the line Home Theatre.	8
TEXT BOOK/Reference Books	1. Modern Television Practice (Fourth revised edition) - R.R.Gulati, New Age InternationalPublishers. 2. Audio and Video Systems (Second Edition) - R.G.Gupta, McGraw Hill EducationLimited. 3. Television & Video Engineering (Second edition) - A.M.Dhake, McGraw Hill EducationLimited. 4. Essential Guide to Digital Video - John Watkinson, Snell & Wilcox Inc.Publication. 5. Guide to Compression - John Watkinson, Snell & Wilcox Inc.Publication 6. Consumer Electronics - S.P.Bali, PearsonEducation.	
REFERENCE BOOKS	1. Bateman, A. and Yates, W. "*Digital Signal Processing Design"*, Computer Science Press,1989. 2. Texas Instrument "*Digital Signal Processing Applications with the TMS320 Family*", Prentice-Hall,1988. 3. Texas Instruments, "Linear Circuits: *Data Conversion, DSP Analog Interface, and Video Interface*", 1992	

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Analyze important basic concepts of Digital Signal Processing and the issues related to computational accuracy of algorithms when implemented using Programmable Digital SignalProcessors.
CO2	Express architectural features of programmable DSP devices based on the DSP operations these devices are generally required toperform
CO3	Implement Know the architecture and programming of programmable DSP devices (DSP320C54XX Processor).
CO4	Demonstrate basic DSP algorithms in programmable DSP devices (DSP320C54XX Processor).
CO5	Evaluate Interfacing memory and serial and parallelI/peripherals to programmable DSP devices (DSP320C54XX Processor)..

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2	-	-	-	-	2
CO2	3	3	3	3	3	3	2	-	-	-	-	2
CO3	3	3	3	3	3	3	2	-	-	-	-	2
CO4	3	3	3	3	3	3	2	-	-	-	-	2
CO5	3	3	3	2	3	3	2	-	-	-	-	2

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Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	3	3	3	3	3	3	2	-	-	-	-	2