Babu Banarasi Das University, Lucknow
Department of Electronics & Communication Engineering
School of Engineering
Bachelor of Technology
Evaluation Scheme (w.e.f from session 2015-16)

Course Category	Semester								Total Credits	%age
	I	II	III	IV	V	VI	VII	VIII		
F	10	16							26	12.44
C	17	10	25	25	25	21	12	12	147	70.33
GE						4	8	8	20	9.57
OE							4	4	8	3.83
GP	1	1	1	1	1	1	1	1	8	3.83
Total	28	27	26	26	26	26	25	25	209	100

Credit Summary Chart

Discipline wise Credit Summary Chart

Course Category	Semester								Total Credits	%age
	I	II	III	IV	V	VI	VII	VIII		
Basic Sciences	12	10	4	3					29	13.87
Humanities& Social Sciences	5		2	2	3	3			15	7.18
Engineering Sciences	10	16							26	12.44
Professional Subject – Core			19	20	22	17	10	4	92	44.01
Professional Subject – Generic Elective						4	8	8	20	9.57
Professional Subject – Open Elective							4	4	8	3.83
Project Work, Seminar and/or Internship in Industry or elsewhere/GP	1	1	1	1	1	2	3	9	19	9.09
Total	28	27	26	26	26	26	25	25	209	100

SEMESTER III									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	BHS2301/ BHS2302	Industrial Psychology / Industrial Sociology	2	0	0	40	60	100	2
C	BAS2301	Complex Analysis and Integral Transforms	3	1	0	40	60	100	4
C	BEC2301	Digital Electronics	3	1	0	40	60	100	4
C	BEC2302	Semiconductor Materials & Analog Circuits	3	1	0	40	60	100	4
C	BEC2303	Electronics Measurements & Instrumentation	3	0	0	40	60	100	3
C	BCS2305	Programming in 'C'	3	1	0	40	60	100	4
Practical / Training / Project									
C	BEC2351	Digital Electronics Lab-I	0	0	2	40	60	100	1
C	BEC2352	Electronics Lab	0	0	2	40	60	100	1
C	BEC2353	Electronics Measurements & Instrumentation Lab	0	0	2	40	60	100	1
C	BCS2355	'C' Programming Lab	0	0	2	40	60	100	1
GP	GP2301	General Proficiency	-	-	-	100	-	100	1
		Total	16	5	8	500	600	1100	26

SEMESTER IV									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	BHS2402/ BHS2401	Industrial Sociology / Industrial Psychology	2	0	0	40	60	100	2
C	BAS2401	Statistical and Numerical Techniques	3	0	0	40	60	100	3
C	BEC2401	Advance Analog Circuits	3	1	0	40	60	100	4
C	BEC2402	Computer Architecture and Organization	3	1	0	40	60	100	4
C	BEC2403	Signals and Systems	3	1	0	40	60	100	4
C	BEE2402	Network Analysis and Synthesis	3	1	0	40	60	100	4
Practical / Training / Project									
C	BEC2451	Advance Analog Circuits Lab	0	0	2	40	60	100	1
C	BEC2452	Computer Organization Lab	0	0	2	40	60	100	1
C	BEC2453	Electronics Workshop & PCB Lab	0	0	2	40	60	100	1
C	BEE2452	Network Lab	0	0	2	40	60	100	1
GP	GP2401	General Proficiency	-	-	-	100	-	100	1
		Total	17	4	6	460	540	1000	26

SEMESTER V									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	BHS2501	Engineering and Managerial Economics	3	0	0	40	60	100	3
C	BEC2501	Analog Communication System	3	1	0	40	60	100	4
C	BEC2502	Microprocessor	3	1	0	40	60	100	4
C	BEC2503	Antenna and Wave Propagation	3	0	0	40	60	100	3
C	BEE2502	Control System	3	1	0	40	60	100	4
C	BEE2504	Electromagnetic Field Theory	3	1	0	40	60	100	4
Practical / Training / Project									
C	BEC2551	Communication Lab-I	0	0	2	40	60	100	1
C	BEC2552	Microprocessor Lab	0	0	2	40	60	100	1
C	BEE2552	Control System Lab	0	0	2	40	60	100	1
GP	GP2501	General Proficiency	-	-	-	100	-	100	1
		Total	18	3	8	500	600	1100	26

SEMESTER VI									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	BHS2601	Industrial Management	3	0	0	40	60	100	3
C	BEC2601	Digital Signal Processing	3	1	0	40	60	100	4
C	BEC2602	Microwave Engineering	3	1	0	40	60	100	3
C	BEC2603	Digital Communication System	3	1	0	40	60	100	4
C	BEC2604	VLSI Technology	3	0	0	40	60	100	3
GE		Generic Elective - I	3	1	0	40	60	100	4
Practical / Training / Project									
C	BEC2651	Digital Signal Processing Lab	0	0	2	40	60	100	1
C	BEC2652	Microwave Engineering Lab	0	0	2	40	60	100	1
C	BEC2653	Communication Lab-II	0	0	2	40	60	100	1
C	BEC2654	Seminar	0	0	2	100	-	100	1
GP	GP2601	General Proficiency	-	-	-	100	-	100	1
		Total	18	4	8	560	540	1100	26

- The student needs to undergo a 4-6 weeks of industrial training that will be evaluated in the VIIth semester.

SEMESTER VII									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	BEC2701	Optical Communication	3	1	0	40	60	100	4
C	BEC2702	Data Communication Networks	3	1	0	40	60	100	4
GE		Generic Elective-II	3	1	0	40	60	100	4
GE		Generic Elective-III	3	1	0	40	60	100	4
OE		Open Elective – I *	-	-	-	40	60	100	4
Practical / Training / Project									
C	BEC2751	CAD of Electronics Lab	0	0	2	40	60	100	1
C	BEC2752	Electronics Circuit Design Lab	0	0	2	40	60	100	1
C	BEC2753	Industrial Training Evaluation	0	0	2	100	-	100	1
C	BEC2754	Project – I #	0	0	2	100	-	100	1
GP	GP2701	General Proficiency	-	-	-	100	-	100	1
		Total	12	4	8	580	420	1000	25

* Student will opt anyone of the open elective from the list of open electives provided by the university.

Student need to submit an abstract for the project, select a guide and will complete at least 20% of the project work.

SEMESTER VIII									
Course Category	**Course Code**	**Course Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	BEC2801	Wireless Communication	3	1	0	40	60	100	4
GE		Generic Elective-IV	3	1	0	40	60	100	4
GE		Generic Elective-V	3	1	0	40	60	100	4
OE		Open Elective – II**	-	-	-	40	60	100	4
Practical / Training / Project									
C	BEC2851	Project –II##	0	0	16	160	240	400	8
GP	GP2801	General Proficiency	-	-	-	100	-	100	1
		Total	9	3	16	300	300	900	25

** Student will opt anyone of the open elective from the list of open electives provided by the university. The opted subject should be different from the one selected in VIIth semester.

This is in continuation with project work started in VIIth semester. In this semester the student will complete the project.

List of Open Elective offered by Department of Electronics and Communication Engineering.

Course Category	Course Code	Open Elective	L	T	P
OE	OEC2001	Nanotechnology	3	1	0

Generic Elective – I		
1.	BEC2011	Microcontroller
2.	BEC2012	Advanced Semiconductor Devices
3.	BEC2013	Introduction to RADAR Systems
4.	BEC2014	Data Structure

Generic Elective – II		
1.	BEC2021	Satellite Communication
2.	BEC2022	Telecom Network Management
3.	BEC2023	Introduction to Optoelectronics
4.	BEC2024	Network Security

Generic Elective – III		
1.	BEC2031	VLSI Design
2.	BEC2032	Microwave Integrated Circuit Design
3.	BEC2033	Embedded Systems
4.	BEC2034	Analog Signal Processing

Generic Elective – IV		
1.	BEC2041	Optical Networks
2.	BEC2042	Ultra Wideband Communication
3.	BEC2043	Information Theory and Coding
4.	BEC2044	Artificial Neural Network

Generic Elective – V		
1.	BEC2051	Electronics Switching
2.	BEC2052	Television Engineering
3.	BEC2053	Biomedical Instrumentation
4.	BEC2054	Introduction to Digital Image Processing

BEC2101/BEC2201 BASIC ELECTRONICS ENGINEERING

Course Objective:

This course provides

1. Comprehensive idea about basic electronics devices like Diodes, BJT, JFET, MOSFET, Operational Amplifier.
2. Fundamental principles of Electronic instruments like CRO and digital multimeter.
3. Fundamental principle of communication.

Learning Outcome:

At the end of the course students will be able to gain knowledge about the

1. Fundamentals of electronic devices like Diodes, BJT, JFET, MOSFET, Operational Amplifier and Electronic instruments like CRO and digital multimeter.
2. Number system, Boolean algebra, logic gates, Kaurnaugh map
3. Basics of communication systems.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**DIODES :** Energy band theory, Semiconductor material, PN junction: Forward and Reverse Bias characteristics, Diode as Rectifier: Half wave and Full wave Rectifiers, Breakdown Mechanism: Zener & Avalanche breakdown, Zener Diode and its application, LED, LCD, and Solar Cell.	30 Hours	1
II	**TRANSISTORS** Construction of Bipolar Junction Transistor: PNP and NPN, Working of Transistor, BJT configurations: CE, CB and CC, Input & Output characteristics of CB & CE configuration, Biasing: Fixed bias, Emitter bias, Potential divider bias, Comparison of biasing circuits. JFET: Basic construction and characteristics, Concept of pinch off, maximum drain saturation current, Input and transfer characteristics, Biasing: Self bias and fixed bias. MOSFET- Depletion and Enhancement type MOSFET- construction, operation and characteristics.	30 Hours	1
III	**DIGITAL ELECTRONICS AND COMMUNICATION SYSTEM** Number System, Complements, Boolean Algebra: Basic Theorems and De Morgan Theorems, Standard logic gates, Universal Logic Gates, Implementation of	30 Hours	1

	Boolean function using Basic gates and Universal gates, Reduction of Boolean function using K-Map upto4variables. Block Diagram of Communication System, Electromagnetic spectrum, Need for Modulation, Basic Definitions AM,FM,PM		
IV	**OPERATIONAL AMPLIFIER AND ELECTRONIC INSTRUMENTS** Introduction to OP-AMP, Characteristics of ideal OP-AMP, Basics of ideal and practical OP-AMP, Configurations: Open loop and closed loop, Applications of OP-AMP, Inverting amplifier , Non-inverting amplifier, Voltage follower, summing amplifier, Integrator and Differentiator. Introduction and Basic Principle of CRT, Block Diagram of CRO, Introduction and Basic Principle of Digital Multimeter	30 Hours	1

Text Books:

1. Robert L. Boylestad and Louis Nashelsky Electronic Devices and Circuit Theory,Pearson India.
2. Kennedy,Electronic Communication System,TMH
3. Kalsi H.S,,Electronic Instrumentation,TMH
4. M.Morris Mano,Digital Logic and Computer Design, PHI

Reference Books:

1. Jacob Millman, Christos C. Halkias, Integrated Electronics: Analog and Digital Circuits and Systems (McGraw-Hill electrical and electronic engineering series).
2. William D. Cooper, Albert D.Hefrick, Modern Electronic instrumentation and measurement technique 5th edition Prentice Hall Of India, New Delhi 1997.
3. Ramakant Gaikwad .Op –Amp's & linear Integrated Circuits, 4th edition, Prentice Hall of India, New Delhi 2002.
4. Albert Paul Malvino, Donald P Leach , Digital Principle & Application 4th edition, Tata McGraw –Hill Edition , New Delhi -1991.

BEC2301 DIGITAL ELECTRONICS

Course Objective:

1. Learning codes used in digital circuits and study gate and minimization of logical expressions.
2. Learning of combinational circuits design and logic families of digital circuits.
3. Learning of Flip Flops, sequential circuits design analysis and synthesis of synchronous circuits and state machine design.
4. Learning of semiconductor memory, Hazard in digital circuits and design of Algorithm State Machine.

Learning Outcome:

1. Students will be able to minimize logic circuits and have knowledge of different types of gate and number system.
2. Students will be able to design Combinational circuits and have knowledge of different logic family circuits.
3. Students will have knowledge of Flip Flops and they can design sequential circuits.
4. Students will have knowledge of semiconductor memories, hazards occurs in digital circuits and design of algorithm state machine.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Number system and Boolean Algebra:** Review of number system, Signed Binary numbers, BCD code, Excess-3 code, Gray code, Review of Boolean Algebra, Logic Gates, Logic implementation using NAND and NOR gate, Canonical and standard form of Boolean function, Logic minimization: Karnaugh map simplification, don't care condition, Tabulation method.	30 Hours	1
II	**Combinational circuits and Logic Families:** Design procedure of combinational circuit: Half adder and Full adder, Half subtractor and Full subtractor, Binary Adder, Decimal Adder, Magnitude Comparator, Encoder and Decoder, Multiplexer and Demultiplexer,	30 Hours	1

	Logic Families: Transistor inverter, RTL, Diode logic, DTL,TTL, Brief introduction to DCTL,I^2L,HTL,ECL and MOS logic.		
III	**Sequential Circuits:** Flip-flops: SR, JK, D and T, Master slave FF, Registers: Buffer registers, shift registers, Counters: Asynchronous and synchronous counters, Basic models of sequential M/C, Analysis of asynchronous and synchronous circuits, Synthesis of completely and incompletely specified synchronous sequential M/Cs, State M/Cs.	30 Hours	1
IV	**Interface circuits:** Memories, PLD, RAM, ROM, Hazards. Algorithm State Machine design with example, Asynchronous sequential logic.	30 Hours	1

Text Books:

1. M. Morris Mano, "Digital Logic Design", PHI
2. S. Salivahanan& S. Arivazhagan, "Digital Circuits and Design", Vikas Publishing.

Reference Books:

1. Malvino & Leach, "Digital Principles and Applications", TMH.
2. R.P. Jain, "Modern Digital Design", TMH.
3. Ronald J Tocci , "Digital Systems, Principles and Applications", PHI.
4. Taub& Schilling, "Digital Integrated Electronics", TMH.

BEC2302 SEMICONDUCTOR MATERIALS AND ANALOG CIRCUITS

Course Objective:

1. To understand physical operation of basic semiconductor devices like BJT, JFET, MOSFET etc.
2. To understand DC and AC models of semiconductor devices.
3. To apply concepts of DC and AC modelling of semiconductor devices for the design and analysis.

Learning Outcome:

At the end of this course, the students will be able to understand the following points:

1. The voltage current characteristics of semiconductor devices like diode, BJT etc.
2. Relate dc and ac models of semiconductor devices with their physical operation.
3. Design and analysis of electronic circuits like CB,CE amplifiers.
4. Design analog system and components.

Course Contents:

Module	**Course Topics**	**Total Hours**	**Credits**
I	**Semiconductor Material Properties And Special diodes:** Review of Fundamentals of Semiconductors, Charge Carrier in semiconductors, Carrier concentration in an intrinsic semiconductor, Junction properties. Metal Semiconductor Junction: Rectifying Contact and Ohmic Contact, Heterojunctions. Special diodes**:** Tunnel diode, Varactor diode, Schottky diode, Photo diode, Photodetector.	30 Hours	1
II	**Diode circuits& Power Supply:** Ideal and Practical diode, Power Supply: Block diagram of Power Supply, Half wave Rectifier and Full wave Rectifier, Clipper, Clamper, Filter circuits, Voltage regulation, Voltage regulation using shunt & series regulator circuits ,Voltage regulation using IC.	30 Hours	1

III	**BJT Amplifiers** BJT Working and Operations**,** Biasing circuits**,** BJT models**:** Ebersmoll model**,** The "r_e" model of transistor**,** Analysis of transistor amplifier using h- parameters, BJT amplifier : CE,CB,CC configuration**,** Midband analysis of small signal amplifiers**,** Frequency response of Amplifier**.** Multistage Amplifier**,** Power Amplifier, Tuned Amplifier.	30 Hours	1
IV	**FET Amplifiers:** Operation, working and characteristics, Analysis and design of different biasing circuits for FET amplifiers. Small-signal model of FET: CS, CG, CD configuration, Low-frequency & High-Frequency analysis of CS, CG and CD amplifiers. MOSFET: Basic Structures, Working & Characteristics, MOSFET Biasing: Fixed bias, Self bias and Voltage divider bias.	30 Hours	1

Text books:

1. Boylestad & Neshelsky, "Electronic Devices & Circuits", 10th Ed, PHI.
2. Streetman & Banerjee, "Solid State Electronics Devices", PHI.

Reference Books:

1. Adel S. Sedra& Kenneth C. Smith, "Microelectronic Circuits", Oxford.
2. Millman&Halkias, "Electronic Devices And circuits", TMH.
3. Salivahanan, Kumar &Vallavaraj, "Electronic Devices & Circuits", TMH.

BEC2303 ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

Course Objective:

1. To understand basic principle and working of sensors and transducers.
2. To understand various components used in Electronic Measurement.
3. To understand principles of advanced electronic instruments.
4. To understand the application of electronics parameters in measurements.

Learning Outcome:

1. Students will learn measurement of physical parameters using transducers such as inductive, resistive, capacitive etc.
2. Students will learn principle and working of various sensors like piezoelectric, thermoelectric and photoelectric.
3. They will become familiar with basics of instruments and details of operation of measuring instruments and their applications.
4. They will become familiar with operation, controls and measurements using CRO.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Theory of Measurement:** Introduction to Measuring Instrument And Systems, Characteristics of Instruments (Static and Dynamic Characteristics). Error analysis: Sources, Types of Errors, Statistical analysis of Random errors. Instrument Calibration: Direct and Indirect Comparison Method, Sensors and Transducers, Passive transducers: Resistive, Inductive and Capacitive, Active transducers: Thermoelectric, piezoelectric & photoelectric, Bridges: AC bridges and DC bridges, Q meter.	30 hours	1
II	**Analog Meter & Digital Meter** Classification**,** Operating Forces**,** Constructional Details**,** Types of supports**,** Balancing Torque/Weight ratio**,** Deflecting Systems**,** Control Systems**,** Damping Systems**,** Galvanometers**:** Dynamic behavior of galvanometer**,** PMMC instrument, Ammeters, Voltmeter and Ohmmeter, Electrodynamometer Instruments, multimeter. Analog to digital converter, A/D Conversion techniques and its characteristics.	30 Hours	1

	Digital to analog converter, D/A conversion techniques, characteristics and its conversion.		
III	**Oscilloscopes & RF Measurements-** Cathode ray oscilloscope**:** Block diagram of CRO**,** Specifications and controls**,** Sweep modes and Role of delay line, Single and Dual-beam CRO, Dual-trace CRO**,** Chop and alternate modes**,** Measurement of voltage, frequency time & phase. High frequency measurements – RF impedance. Types of oscilloscopes: Analog Storage Oscilloscope and Digital Storage Oscilloscope, Signal Generators: Sine-wave generator and Non- sinusoidal, Function generators, Frequency synthesis techniques, Digital signal generators, Signal Analyzers : Distortion, Wave and Network spectrum analyzer	30 Hours	1

Text Books

1. A.K.Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", DhanpatRai.
2. David A. Bell, "Electronic Instrumentation and Measurements", 2nd Ed., PHI.

Reference Books

1. Albert D. Helfrick, William David Cooper, "Modern electronic instrumentation and measurement techniques", TMH.
2. Oliver Cage, "Electronic Measurements and Instrumentation", TMH.
3. Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (ButerworthHeinmann), 2008.
4. H.S. Kalsi, "Electronics Instrumentation", TMH Ed.
5. MMS Anand, "Electronic Instruments & Instrumentation Technology", PHI Pvt. Ltd., New Delhi Ed.

BEC2351 DIGITAL ELECTRONICS LAB- I

Note: Minimum of 8 experiments are to be performed from the following list:

1. Study of different basic digital logic gates and verification of their Truth Table.
2. Study and verification of the law of Boolean algebra and De-Morgan's Theorem.
3. Construction and verification of various combinational circuits such as Half Adder, Full Adder, Half Subtrator and Full Subtractor.
4. Study of Different Code Converters, Encoder, Decoder.
5. Study of Magnitude Comparator.
6. Study of Multiplexer and De-multiplexer.
7. Construction and verification of various types of Flip-Flops using gates and IC's.
8. Construction and Verification of different Shift Registers.
9. Construction and verification of different types of Counters.
10. Study of important TTL technologies, Verifications of important TTL Circuit Parameters.

BEC2352 ELECTRONICS LAB

Note: Minimum of 8 experiments are to be performed from the following list:

1. Diode Characteristic
   a) PN junction diode Characteristics, Static and Dynamic resistance measurement from graph.
   b) To plot Zener diode Characteristics curve.
2. Clipper Clamper
   a) To plot the Characteristics curve of various clamper circuits.
   b) To plot the Characteristics curve of various clipper circuits.
3. Half wave, full wave & bridge rectifier
   a) To measure Vrms, Vdc for half wave, full wave & bridge rectifier.
   b) To measure ripple factor, ratio of rectification for full wave & half wave rectifier.
4. Voltage regulation using zener diode shunt regulator and transistor series voltage regulator in the following cases
   a) Varying input
   b) Varying load
5. Characteristic of BJT
   a) To plot the input-output Characteristics curve in CB & CE configuration
   b) To find α & β and Q point from the above curve.
6. h- Parameter
   To measure h- parameter (Av, Ai, Ro &Ri) in CE Amplifier
7. Multi Stage Amplifier
   a) To plot the Characteristics curve for Direct Coupled Amplifier.
   b) To plot the Characteristics curve for RC Coupled Amplifier.
   c) To plot the Characteristics curve for transformer Coupled Amplifier.
8. FET Characteristic
   a) To plot the Characteristics curve for n channel – JFET in CS configuration.
   b) To find out pinch off voltage from the above characteristics curve.
9. Op-Amp parameters measurement.
10. Power Amplifier
    a) Study of class A power Amplifier.
    b) Study of class B complementary symmetry Amplifier.

BEC2353 ELECTRONICS MEASUREMENTS & INSTRUMENTATION LAB

Note: Minimum of 8 experiments is to be performed from the following list:

1. Calibration of AC Voltmeter and AC Ammeter.
2. Characteristics of LVDT.
3. Measurement of unknown resistance by Wheatstone bridge and bridge sensitivity.
4. Measurement of low resistance using Kelvin's double bridge.
5. Measurement of capacitance by De Sauty's and Schering Bridge.
6. Measurement of Inductance by Anderson's Bridge and Maxwell's Bridge.
7. Measurement of Inductance by Hay's Bridge.
8. Study of L.C.R. Bridge and determination of the value of the given components.
9. Study of semiconductor diode voltmeter and its uses as DC average responding AC volt meter.
10. Measurement of Power & Power factor.
11. A/D & D/A converters.
12. Measurement of phase difference and frequency using CRO (Lissajous Pattern).

BEC2401 ADVANCE ANALOG CIRCUITS

Course Objective:

1. To provide knowledge about advance analog electronic circuits.
2. To know the basic concept of feedback and Oscillator circuits.
3. To know the application of op amp as filters and other non linear applications.
4. To know the design of op amp based circuits and timer IC 555.
5. To know the differential amplifier and current mirror circuits and PLL.

Learning Outcome:

Students will acquire knowledge of

1. Feedback circuits and oscillator circuit.
2. Filter design and op amp based non linear circuit design.
3. Op Amp based circuit design and timer IC 555.
4. Differential amplifier and current mirror circuits as well as PLL.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Feedback Amplifiers and Oscillators Circuits:** Feedback concept**,** Feedback connection type**,** Effect of feedback on Gain, Input impedance, Output Impedance. Oscillator: Oscillation Operation**,** Phase shift Oscillator**,** Wien Bridge Oscillator**,** Tuned Oscillator Circuit**,** Colpitts Oscillator and Hartley Oscillator, Crystal Oscillator.	30 Hours	1
II	**Op Amp linear and Non linear application:** Review of Operational Amplifier, Voltage to Current and Current to Voltage converters. Filters: First order and Second order Low pass and High pass filters, Band pass filters, Band reject filters, All pass filters. Non linear circuit: Log Amplifier, Anti-Log Amplifiers, Temperature compensated log and antilog amplifiers, Analog Multipliers and their applications	30 Hours	1

III	**Comparator, Multivibrator and IC 555 Timer:** Zero crossing detector, Schmitt Trigger, Comparator, Precision Rectifiers and Peak Detectors, Sample and Hold Circuits, Generation of square and triangular waveforms, Astable multivibrator, Triangular waveform generator, Monostable multivibrator, Integrated Circuit Timer: The 555 Circuit, Monostable Multivibrator and astable multivibrator using the 555 IC.	30 Hours	1
IV	**Analog integrated circuit design and PLL (IC-565)** Current Mirror using BJT and MOSFET, Simple current mirror, Cascode Mirror, A Bipolar mirror with base current compensation, Wilson current mirror, Widlar current source, Darlington connection, Differential Amplifier, The MOS differential pair, Small signal operation of the MOS differential pair, The BJT differential pair, Other Non ideal characteristics of the differential amplifier, Phase locked loops (PLL): Ex-OR Gates and multipliers as phase detectors, Block Diagram of IC PLL, Working of PLL and Applications of PLL	30 Hours	1

Text Books:

1. Boylestad & Neshelsky, "Electronic Devices & Circuits", 10th Ed, PHI.
2. Adel S. Sedra , Kenneth Carless Smith, "Microelectronic Circuits", Oxford University Press
3. R. A. Gayakwad, "Op-Amps and Linear Integrated Circuits", PHI

Reference Books:

1. Millman&Hailkias, "Electronic Devices and Circuits", TMH.
2. Salivahanan, Kumar &Vallavaraj, "Electronic Devices and Circuits", TMH
3. R.P. Jain, "Modern Digital Design", TMH.
4. D. Roy Chaudhary, Shail Jain, "Linear integrated circuits", New Age International.

BEC2402 COMPUTER ARCHITECTURE AND ORGANISATION

Course Objective:

1. To understand von Neumann architecture and micro operations.
2. To understand register transfer and computer arithmetic.
3. To understand programming and instruction formats.
4. To understand memory organization and pipelining.

Learning Outcome:

1. Students will learn basic of computer.
2. Students will learn micro operations and computer arithmetic.
3. Students will learn about organization and interrupts.
4. Students will learn about memory organization and pipelining.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Basics of computer** Introduction to Computers: Basic of Computer, Von Neumann Architecture, Generation of Computer, Classification of Computers, Instruction Execution, Register Transfer, Bus and Memory Transfer, Tree-State Bus Buffers, Memory Transfer, Micro-Operations: Register Transfer Micro-Operations, Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micro-Operations.	30 Hours	1
II	**Computer arithmetic** Computer Arithmetic: Addition And Subtraction With Signed-Magnitude, Multiplication Algorithm, Booth Multiplication Algorithm, Array Multiplier, Division Algorithm, Hardware Algorithm, Divide Overflow, Floating-Point Arithmetic Operations, Basic Considerations, Register Configuration, Addition And Subtraction, Decimal Arithmetic Operations, BCD		

	Adder, BCD Subtraction.		
III	**Programming,Organization of computer** Programming the basic computer, Machine language, Assembly language, Assembler, First pass, Second pass, Organization of a Computer: Central Progressing Unit (CPU), Stack Organization, Register Stack, Memory Stack, Reverse Polish Notation, Instruction Formats: Three- Address Instructions, Two – Address Instructions, One- Address Instructions, Zero-Address Instructions, RISC Instructions, Addressing Modes Reduced Instruction Set Computer, CISC Characteristics RISC Characteristics. Input-Output Organization: Modes Of Transfer, Priority Interrupt, DMA, Input-Output Processor (IOP), CPUIOP Communication.	30 Hours	1
IV	**Memory organization,Pipelining** Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Cache Memory, Virtual Memory, Address Space and Memory Space, Associative Memory, Page Table, Page Replacement, Parallel Processing and Vector Processing: Pipelining, Parallel Processing, Pipelining General Consideration, Arithmetic Pipeline Instruction Pipeline, Vector Operations, Matrix Multiplication, memory Interleaving.	30 Hours	1

Text book:

1. M Morris Mano, “Computer System Architecture” PHI 3rd Edition

Reference Books:

1. John P Hayes “Computer Architecture and Organisation” McGraw Hilll 3rd Edition.
2. Modern Digital Design, R.P. Jain, TMH.
3. Digital Logic Design, M. Morris Mano, PHI
4. Digital Technology, Virendra Kumar, New Age.

BEC2403 SIGNALS AND SYSTEMS

Course Objective:

1. Coverage of continuous-time (CT) and discrete-time (DT) signals and systems, their properties, representations and methods of analysis.
2. Knowledge of frequency domain representation and analysis using Fourier transform.
3. Concept of sampling and reconstruction of signals.
4. Mathematical and computational skills such as convolution, correlation and spectral density needed in application areas like communication and signal processing.

Learning Outcome:

At the end of this course, the students will be able to understand the following points:

1. To characterize and analyze the properties of CT and DT signals and systems.
2. To analyze CT and DT systems in Time domain.
3. To represent CT and DT systems in the Frequency domain using Fourier Analysis- CTFT and DTFT.
4. To conceptualize the effects of sampling and reconstruction of CT signal.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction of Signals and Systems** Definition, representation and Classification of signals: continuous time (CT) & discrete time (DT) signals, Even & odd signals, Periodic & aperiodic signals, Random & deterministic signals, Energy & power signals, One & multidimensional signals, Some standard signals. Basic Operations on Signals for CT/DT signal, Transformation of independent & dependent variables, Definition of system and their classification: Continuous time & discrete time systems, Linear & non-linear systems, Variant & non-variant systems, Causal & non-causal systems and Static & dynamic systems.	30	1

II	**Linear Time- Invariant Systems** Introduction of LTI system , Convolution for CT and DT signals, Impulse Response representation for LTI Systems, Properties of Impulse Response representation for LTI Systems**,** Differential and Difference Equation representations for LTI Systems**,** Properties of convolution, System interconnection.	30	1
III	**Fourier Transform Representation for Signals** Continuous Time Fourier transform (CTFT): Definition, Existence of Fourier Transform (FT)- Dirichlet Condition, Inverse Fourier transform, Properties of Fourier Transform, Fourier Transform Representations for Periodic Signals, Relation between Laplace Transform & Fourier Transform, Discrete Time Fourier Transform (DTFT): Definition, Existence of DTFT, Comparison between CTFT & DTFT, Properties of DTFT, Parseval's theorem or Rayleigh's Theorem, Sampling and Reconstruction of Continuous-Time Signals, Filtering and Signal Distortion: Time Response and Frequency Response, Linear Distortion and Equalization, Nonlinear Distortion, Ideal Low-Pass Filters, Phase Delay and Group Delay.	30	1
IV	**Spectral Density and Correlation** Spectral Density: Introduction, Energy Spectral Density, Power Spectral Density. Correlation: Correlation of Energy Signals, Correlation of Power Signals, Autocorrelation & Cross correlation and their Properties. Introduction to Noise, Types of Noises, Noise equivalent bandwidth, White Noise.	30	1

Text Books:

1. Simon Haykin, "Signals and Systems", John Wiley.
2. Simon Haykin, "Analog and Digital Communications", John Willey.

Reference Books:

1. H P Hsu, "Signals and Systems-Schaum's Outlines", TMH.

2. Bruce Carlson, “Signals and Systems”, TMH.
3. Oppenheim &Wilsky, “Signals & Systems”, PHI.
4. Taub and Schilling "Principles of communication signals", 2nd ed. New York: Mcgraw-Hill, 1986.

BEC2451 ADVANCE ANALOG CIRCUITS LAB

Note: Minimum of 8 experiments are to be performed from the following list:

1. Transistorized oscillators: Phase shift, Wein bridge, Hartley's &Collpit's.
2. IC 555 Timer: Monostable & Astable operation circuit.
3. IC 565: PLL Applications.
4. IC 566: VCO Applications.
5. Study of A/D, D/A Converters.
6. To study of Op-amp as Adder, integrator & voltage comparator.
7. Study of Op-amp as Astable & Monostable multivibrators.
8. Sampling & reconstruction using Nyquist criteria.
9. Function generator using operational amplifier (single, triangular & sq. wave)
10. FET Amplifiers.
    (a) Single Stage Common source FET amplifier plot of gain (in db) vs frequency.
    (b) Measurement of BW, input impedance, maximum signal handling capacity of an amplifier.
11. Voltage to current & current to voltage converter.
12. Filter design using Op-amp.

BEC2452 COMPUTER ORGANIZATION LAB

List of Experiments:

1. Bread Board Implementation of Flip-Flops.
2. Experiments with clocked Flip-Flop.
3. Design of Counters.
4. Bread Board implementation of counters & shift registers.
5. Implementation of Arithmetic algorithms.
6. Bread Board implementation of Adder and Subtractor (Half, Full) .
7. Bread Board implementation of Binary Adder.
8. Bread Board implementation of Seven Segment Display.

BEC2453 ELECTRONICS WORKSHOP & PCB LAB

1. Study of CRO, DMM & Function Generator.
2. Identification of Active & Passive Components.
3. Winding shop: Step down transformer winding of less than 5VA.
4. Soldering shop: Fabrication of DC regulated power supply
5. PCB Lab: (a) Artwork & printing of a simple PCB.
   (b) Etching & drilling of PCB.
6. Wiring & fitting shop: Fitting of power supply along with a meter in cabinet.
7. Testing of regulated power supply fabricated.

BEC2501 ANALOG COMMUNICATION SYSTEM

Course Objective:

1. To provide the fundamental knowledge of basic communication system.
2. Various modulation and demodulation techniques used in analog communication, noise handling and multiplexing.
3. The working principles of transmitters and receivers used in analog communication systems.

Learning Outcome:

The student will learn:

1. Basic concepts of communication system.
2. Amplitude, frequency and phase modulation techniques.
3. Different types of sampling and PCM system.
4. To detect the errors that occurs due to noise during transmission.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction to Communication system and Amplitude Modulation** Overview of Communication system, Communication channels, Need for modulation, Baseband and Pass band signals, Amplitude Modulation: Concept of Amplitude Modulation, Switching Modulator, Envelope Detector, DSB-SC Modulation, Ring Modulator, Coherent Detection, SSB Modulation, VSB Modulation.	30 Hours	1
II	**Frequency-Modulation Systems** Angle Modulation: Phase and Frequency Modulation, Relationship Between Phase and Frequency Modulation, Phase and Frequency Deviation, Narrowband & Wideband FM, FM Generation: Parameter-Variation Method, Armstrong Method. FM Demodulators, The super heterodyne receiver.	30 Hours	1

III	**Analog to Digital Conversion** The Sampling Theorem, PAM, PPM, PWM, Natural Sampling, Flat-Top Sampling, Signal Recovery through Holding, Quantization of Signals, Quantization Error, Pulse Code Modulation (PCM), Electrical Representation of Binary Digits, The PCM System, Companding, Multiplexing PCM Signals, Differential PCM, Delta Modulation, Adaptive Delta Modulation	30 Hours	1
IV	**Noise** Noise: Shot noise, thermal noise and white noise, Noise equivalent bandwidth, Narrow band noise. Noise in analog modulation: Receiver model, Noise in DSB SC receiver, Noise in AM Receiver, Noise in FM Receiver, Capture effect, Pre emphasis and De-emphasis.	30 Hours	1

Text Book:

1. Simon Haykin," Communication Systems" John Wiley & Sons 5thEdition.

2. Principles of Communication Systems, Taub& Schilling, TMH**.**

References Books:

1. Modern Digital and Analog Communication Systems, B.P. Lathi, OUP

2. Digital Communications: Fundamental And Applications, Sklar, Pearson

3. Digital Communications, Prokias, MGH

4. Communication Systems: Analog and Digital, R Singh,S. Sapre, McGraw Hill.

BEC2502 / BEC2404 MICROPROCESSOR

Course Objective:

1. To learn the generations of microprocessor.
2. To learn the basics, architecture and programming of 8085.
3. To learn the interfacing of microprocessor with various ICs.
4. To learn the basics of 8086 microprocessor.

Learning Outcome:

1. Students will understand basics of computer system and microprocessors.
2. Students will understand practical application and interfacing of microprocessor chips.
3. Deep knowledge about programming in Assembly Language.
4. Students will be able to understand the concepts of higher generation microprocessors.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Microprocessor Architecture and microcomputer system** Microprocessor Architecture and Its Operations, Memory, Input and Output (I/O) Devices, Example of microcomputer system, The 8085 MPU, Memory interfacing, interfacing output display, interfacing input device, Memory mapped I/O.	30 Hours	1
II	**Programming 8085** 8085 programming model, Instruction classification: Data transfer operation, Arithmetic operation, Logic operations and Branch operations. Writing assembly language programs, Debugging a program. Programming techniques: Looping, Counting and Indexing. Time delay programs, Stack, subroutine, Conditional call, Return instruction. Code conversion: BCD to Binary conversion, Binary to BCD and BCD to seven segment LED code conversion.	30 Hours	1
III	**Interfacing Devices**	30 Hours	1

	Digital to analog converter, Analog to digital converter, 8279 programmable Keyboard/display interface, 8255 Programmable peripheral interface: Interfacing Keyboard and Seven segment display, 8254 Programmable interval timer, 8259 Programmable interrupt controller, 8237 DMA controller.		
IV	**8086 microprocessor** 8086 microprocessor: Register organization, Architecture, Signal Description, Physical memory organization, General bus operation, I/O addressing capability, Minimum mode 8086 system and timings, Machine language instruction format, Addressing modes, Assembler directives and Operators.	30 Hours	1

Text Books

1. Microprocessor Architecture and Programming & Application with 8085,Ramesh S Goanker,Wiley Eastern Ltd Fifth edition\
2. Advanced Microprocessor and peripherals, Ray A K,B.M Burchandi,2nd Edition,TMH

Reference Books:

1. Advanced Microprocessors and Interfacing, B. Ram, TMH.
2. Microprocessors and Interfacing by Douglas V. Hall, McGraw Hill International Ed. 1992

BEC2503 ANTENNA AND WAVE PROPAGATION

Course Objective:

1. To study antenna fundamentals, concept of radiation and analyze radiation characteristics.
2. To study types of antennas like loop antenna, helical antenna, biconical antenna, slot antenna and lens antenna.
3. To study radiation wave propagation.

Learning Outcome:

1. Students to have knowledge of antenna fundamentals and its parameters.
2. To study characteristics and types of antennas.
3. Understand wave propagation mechanisms.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Antenna Fundamentals** Basic Concepts: Antenna parameters, Patterns, Beam area, Radiation intensity, Beam efficiency, Directivity and gain. Antenna concepts: Effective aperture, Scattering aperture, Loss aperture, Collative aperture, Physical aperture, Aperture efficiency and Effective height. Short dipole, Friis transmission equation, Duality of antenna, point sources, Antenna Arrays: Linear arrays, Broadside arrays and End fire arrays. Huygens principle, Antenna measurements: Pattern measurement, Phase measurement, Gain and Impedance.	30 hours	1
II	**Types of Antennas** Loop antenna: Small loop and Circular loop. Radiation resistance, Directivity, Square loops, Helical antenna: Helical geometrics, Monofliar helices, Pattern, beam width, gain and impedance, Polyrod-helix, Corner-helix, Two wire line-helix and Helix-lens. Biconical antenna Characteristics: impedance and pattern. Conical and triangular antenna, Brown Woodward (bow tie) antenna, Slot, horn, complementary and Lens antenna.	30 Hours	1
III	**Wave propagation**	30 Hours	1

	Basic types of propagation: Ground wave, Space wave and Sky wave propagation. Sky wave propagation: Structure of ionosphere, Mechanism of refraction, Critical frequency, Skip distance, Effect of earth's magnetic field, Energy loss in ionosphere due to collision, Maximum usable frequency, Fading and diversity. Space wave propagation: Reflection from ground for vertically and horizontally polarized waves, Reflection characteristics of earth, Resultant of direct and reflected ray at receiver and Duct propagation. Ground wave propagation: Attenuation characteristics of ground wave propagation and Calculation of field strength at a distance.		

Text Books:

1. John D. Kraus, Ronald J. Mashefka, " *Antenna for All Applications*", Tata McGraw-Hill, Second Edition, Reprint 2007.
2. K.D. Prasad,"*Antennas and Wave Propagation*" , SatyaPrakashan,Third Edition, Reprint 2005.

Reference Books:

1. C A. Balanis , "*Antenna Theory* ", John Wiley ,Second Edition,2009.
2. Jordan and Balman, "*Electromagnetic Waves and Radiating Systems*", PHI.
3. G. Kennedy and B. Davis, "*Electronic Communication Systems*", Tata McGraw Hill Publishing Company Ltd., Fourth Edition.

BEC2551 COMMUNICATION LAB - 1

List of Experiments:

1. To study DSB/ SSB amplitude modulation & determine its modulation factor & power in side bands.

2. To study amplitude demodulation by linear diode detector

3. To study frequency modulation and determine its modulation factor

4. To study PLL 565 as frequency demodulator.

5. To study sampling and reconstruction of Pulse Amplitude modulation system.

6. To study the Sensitivity, Selectivity, and Fidelity characteristics of super heterodyne receiver.

7. To study Pulse Amplitude Modulation

a. using switching method
b. by sample and hold circuit

8. To demodulate the obtained PAM signal by 2nd order LPF.

9. To study Pulse Width Modulation and Pulse Position Modulation.

10. To plot the radiation pattern of a Dipole, Yagi-uda and calculate its beam width.

11. To plot the radiation pattern of Horn, Parabolic & helical antenna. Also calculate beam width & element current.

12. Design and implement an FM radio receiver in 88-108 MHz.

BEC2552 / BEC2454 MICROPROCESSORS LAB

List of Experiments:

1. Addition of 8 bit numbers series.
2. Addition of two 16 bit numbers.
3. Subtraction of two 8 bit numbers.
4. Multiplication and division of two 8 bit numbers.
5. To find the maximum number in a given string.
6. Binary to gray code conversion.
7. To sort a string of a one byte numbers in ascending order.
8. To sort a string of a one byte numbers in descending order.
9. Interfacing with ADC/DAC.
10. Interfacing with 8253.
11. Interfacing with 8255 in I/O mode.
12. Verification of interrupts.

BEC2601 DIGITAL SIGNAL PROCESSING

Course Objective:

1. To study discrete time system analysis and Z-transform.
2. To study efficient computation of DFT.
3. To study realization and design of filters.
4. To learn the concepts of windows (Hamming, Hanning, Blackmann and Kaiser).

Learning Outcome:

1. Students will understand z- transform analysis.
2. Learn to realize filter structures.
3. Design IIR and FIR filters.
4. Students will be able to learn the concepts of Window design.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Discrete time system analysis and Z Transform** Discrete Fourier transform: The Discrete Fourier transform, The DFT as linear transform. Properties of DFT: Periodicity, linearity and symmetry property, additional properties of DFT, Multiplication of two DFT and circular convolution. Relationship of the DFT to Other transforms. Z transform: Properties of Z-transform, Inverse Z-transform.	30 Hours	1
II	**Efficient Computation of DFT** Efficient computation of the DFT: FFT algorithms, Direct computation of the DFT, Radix-2 FFT algorithms, Efficient computation of the DFT of two real sequences, Efficient computation of the DFT of a 2N point real sequences, Gortezel algorithm, Chirp Z-transform algorithm.	30 Hours	1
III	**Realization of Filter Structures** IIR Filter Structure: Direct forms structure, Cascade form	30 Hours	1

	structure, Parallel form structure and signal flow graph. FIR Filter Structures: Direct form structure, frequency sampling structure, lattice structure and Cascade form structure.		
IV	**Design of filters** Design of IIR Filters from Analog Filters: IIR filter design by approximation of derivatives, IIR filter design by impulse invariance, IIR filter design by the Bilinear transformation, Matched-z transformation, Butterworth filter, Chebyshev filter: Characteristics of commonly used analog filters. Design of FIR Filter : Symmetric and anti-symmetric FIR Filters, Design of linear-phase FIR Filters using windows, Design of linear-phase FIR filters by the frequency sampling method, Design of equiripple linear phase FIR filters and Hilbert transformers.	30 Hours	1

Text Books:

1. J.G. Proakis & D.G. Manolakis, Digital Signal Processing, Principles, Algorithms and Applications, PHI/Pearson.
2. S. Salivahanan et al, Digital Signal Processing, TMH.

Reference Books:

1. L.R. Rabiner & B.Gold, Theory and Application of Digital Signal Processing., PHI
2. Meyer-Basse U, Digital Signal Processing with FPGA, Spriger India
3. Babu R, Digital Signal Processing , Scitech
4. S.K.Mitra, Digital Signal Processing - A Computer based approach, TMH
5. Pradhan, Digital Signal Processing Applications, Jaico

BEC2602 MICROWAVE ENGINEERING

Course Objective:

1. To understand principles of microwave devices.
2. To learn various types of microwave tubes like klystron, magnetron, etc.
3. To learn measurement of microwave components and parameters.

Learning Outcome:

1. Learn design criteria for waveguide and coaxial microwave components.
2. Learn different types of microwave tubes like klystron, magnetron, travelling wave tube, etc.
3. Work in small teams and design, fabricate and test useful microwave components.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Microwave waveguides and components** Rectangular waveguides: Solutions of wave equations in rectangular coordinates, TE mode, TM mode, TEM mode1, Power transmission, Power losses and Excitation of modes. Circular waveguides: Solutions of wave equations in cylindrical coordinates, TE mode, TM mode, TEM mode, Power transmission, Power losses and Excitation of modes. Microwave cavities: Rectangular cavity resonator, Circular cavity resonator and Q factor of cavity resonator. Microwave hybrid circuits: Waveguide tees, Magic tees, Rat race circuits, Waveguide corners, bends and twists. Directional couplers: Two hole directional coupler, S matrix of directional coupler and Hybrid couplers, Circulators and isolators, Strip lines, Microstrip lines, Parallel strip lines, Coplanar strip lines and Shielded strip lines.	30 Hours	1
II	**Microwave Tubes** Klystrons: Re-entrant cavities, Velocity modulation process, Bunching process, Output power and beam loading. Multicavity klystron amplifiers: Beam current density, Output current and output power of two-cavity klystron and Output power of four-cavity klystron. Reflex klystrons: Velocity modulation, Power output,	30 Hours	1

	efficiency and electronic admittance. Travelling wave tubes: Slow wave structures, Amplification process, Convection current, Axial electric field, wave modes and gain consideration. Magnetrons: Cylindrical magnetron, Linear magnetron, Coaxial magnetron, Voltage tunable magnetron, Inverted coaxial magnetron and Frequency agile coaxial magnetron. Backward wave oscillator.		
III	**Microwave Measurements** General set up of microwave test bench, Slotted line carriage, VSWR meter, Microwave power measurement techniques, Crystal detector, Frequency measurement, Wavelength measurement, Impedance and reflection coefficient, Insertion and attenuation loss measurements, Measurement of antenna characteristics, Microwave link design.	30 Hours	1

Text Books:

1. Samuel Y. Liao, "*Microwave Devices and Circuits*", 3rd Ed, Pearson Education.
2. A. Das and S. K. Das, "*Microwave Engineering*", TMH.

Reference Books:

1. R.E Collin, "*Foundation for Microwave Engineering* ", 2nd Ed., John Wiley India.
2. David M. Pozar, "*Microwave Engineering*", 4th Ed, John Wiley & Sons Inc.
3. G. Kennedy and B. Davis, "*Electronic Communication Systems*", Tata McGraw Hill Publishing Company Ltd., Fourth Edition.

BEC2603 DIGITAL COMMUNICATION SYSTEM

Course Objective:

1. To provide the fundamental knowledge of digital communication systems.
2. Design optimum receivers for digital modulation techniques.
3. Analyze the error performance of digital modulation techniques.
4. Design digital communication systems under given power spectral and error performance constrains.

Learning Outcome:

The student will

1. Learn to identify the functions of different components of a digital communication system.
2. Learn about random variables and random process.
3. Be able to compute and compare the probability of error for several demodulators.
4. Understand about information theory and spreading techniques.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Principles of Digital Data Transmission** Digital communication system, Line Coding, Pulse shaping, Scrambling, Digital receivers and Regenerative Repeaters, Eye diagram, PAM: M-ary Baseband Signalling for Higher Data Rate, Digital Carrier Systems, M-ary Digital Carrier Modulation.	30 Hours	1
II	**Fundamentals of Probability theory and Random Processes** Concept of Probability, Random variables, Statistical averages (Means), Correlation, Sum of Random Variables, Central Limit Theorem, From Random Variable to Random Process, Classification of Random Processes, Power spectral density, Multiple Random Processes.	30 Hours	1

III	**Performance Analysis of Digital communication systems** Optimum linear Detector for Binary polar signaling, General Binary Signaling, Coherent Receivers for Digital Carrier Modulations, Signal Space Analysis of Optimum Detection, Vector Decomposition of White Noise Random processes, General Expression for Error Probability of optimum receivers.	30 Hours	1
IV	**Information Theory and Spread spectrum modulation** Unit of Information, Entropy, Rate of Information, Joint Entropy & Conditional Entropy, Mutual Information, Channel Capacity, Shannon's Theorem, Coding Efficiency, Shannon-Fano Coding, Error Control Coding, Block Code, Cyclic Code, Convolution Code, Pseudo-Noise Sequences, Direct Sequence Spread Spectrum (DS/SS), Frequency Hopping Spread Spectrum(FH/SS) systems, Applications of Spread Spectrum.	30 Hours	1

Text Books:

1. B.P Lathi, "Modern Digital & Analog Communication Systems", Oxford University Press, Fourth Edition, 2010.

2. R.P.Singh& S.D. Sapre, "Communication Systems Analog and Digital" Tata McGraw Hill.

References Books

1. Simon Haykin , "Digital Communication" , John Wiley , Fourth Edition, Reprint 2009.

2. Taub& Schilling, "Principles of Communication Systems", TMH.

3. Sklar, "Digital Communications: Fundamental And Applications", Pearson.

4. Prokias , "Digital Communications",TMH .

BEC2604 VLSI TECHNOLOGY

Course Objective:

1. To develop background VLSI fabrication technology.
2. To understand the process of different crystal wafer preparation.
3. To understand the different levels of IC fabrication.
4. To understand the issues related to metallization and packaging.

Learning Outcome:

Student will get knowledge about
1. Different methods of crystal wafer preparation.
2. Various steps involved in IC fabrication.
3. Precautionary actions taken during IC fabrication.
4. The need of metallization and packaging

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**IC TECHNOLOGY, EPITAXY, OXIDATION** Introduction to IC Technology, Crystal Growth Wafer Preparation, Electronic Grade Silicon, Czochralski Crystal Growth, Silicon Shaping, Processing Considerations. Epitaxy: Vapor–Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation. Oxidation: Growth Kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxides Properties.	30 Hours	1
II	**LITHOGRAPHY,DIFFUSION** Lithography: Optical Lithography, Photo masks, Wet Chemical Etching. Dielectric and Polysilicon Film Deposition: Deposition Processes, Polysilicon, Silicon Dioxide, Silicon Nitride. Diffusion: Diffusion of Impurities in Silicon and Silicon Dioxide, Diffusion Equations, Diffusion Profiles, Diffusion Furnace, Solid, Liquid and Gaseous Sources, Sheet Resistance and its measurement. Ion-Implantation: Ion-Implantation	30 Hours	1

	Technique, Range Theory, Implantation Equipment.		
III	**METALLIZATION, PACKAGING** Metallization: Metallization Application, Metallization Choices, Physical Vapor Deposition, Vacuum Deposition, Sputtering Apparatus. Packaging of VLSI devices: Package Types, Packaging Design Consideration, VLSI Assembly Technologies, Package Fabrication Technologies.	30 Hours	1

Text book:

1. S. M. Sze , "VLSI Technology", Tata McGraw –Hill, Second Edition,1988.

References:

1. Douglas A. Pucknell , Kamran Eshraghian, " Basic VLSI Design", Prentice-Hall of India, Third Edition.
2. John P. Uyemura , "CMOS Logic Circuit Design", Kluwer Academic Publishers New York, Boston, Dordrecht, London, Moscow, Reprint 2002.
3. Plummer , "Silicon VLSI Technology", Pearson Education, First Edition,2001.

Generic Elective –I

BEC2011 MICROCONTROLLER

Course Objective:

1. To provide basic knowledge of microcontrollers.
2. Understanding the concepts of assembly language programming of microcontroller.
3. Understanding the basics of interfacing of microcontrollers.

Learning Outcome:

Student will be able

1. To interface microcontroller with the devices.
2. To understand different parameters of microcontroller IC 8051.
3. To program microcontroller IC 8051.
4. To interface microcontroller IC 8051 with other devices.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction** Overview of the 8051 family, Inside the 8051, 8051 data types and directives, 8051 flag bits and PSW register, 8051 Register bank and stack, Addressing modes: Immediate and Register addressing modes, Accessing Memory using various Addressing Modes, Bit Address for I/O and RAM, Extra 128 byte on chip Ram on 8052	30 Hours	1
II	**Microcontrollers – 8051** 8051 interrupts, Loop and jump instructions, Call instructions, Time delay for various 8051 chips. I/O port programming: 8051 I/O programming, I/O bit manipulation programming, Arithmetic and logic instructions: Arithmetic instructions, Signed number concepts and arithmetic operations, Logic and compare instructions, Rotate instruction and data serialization, BCD , ASCII and other application programs.	30 Hours	1

III	**8051 programming in C** Data types and time delay in 8051 C, 3.2 I/O programming in 8051 C, logic operations in 8051 C, Data conversion programs in 8051 C, Data serialization in 8051 C. Timer programming: Programming 8051 timers, Counter programming. Serial port programming: Basics of serial communication, 8051 connection to RS-232, 8051 serial port programming, Programming the second serial port.	30 Hours	1
IV	**Interfacing 8051** LCD interfacing, Keyboard interfacing, Parallel and serial ADC, DAC interfacing, Interfacing to external memory, 8255 interfacing, Relays and opto isolators, Stepper motor interfacing, DC motor interfacing and PWM.	30 Hours	1

Text Books:

1. The 8051 Microcontroller and embedded systems-Muhammad Ali Mazidi, Janice Gillespie Mazidi, Rollin D McKinley , Pearson , Second Edition
2. Microcontroller Theory and Applications, Ajay V Deshmukh,TMH@2005

Reference Books:

1. Ayala Kenneth, “The 8051 Microcontroller”, Cengage Learning, 3rd Edition.
2. Shah Satish, “ 8051 Microcontrollers MCS 51 Family and its variants”, Oxford Publications.

BEC2012 ADVANCE SEMICONDUCTOR DEVICES

Course Objective:

1. Understand the basic properties of semiconductor materials and devices.
2. Understanding of existing devices, their principles and applications.
3. Understanding the fundamentals of transistors like MESFET, MOSFET.
4. Understanding of various optoelectronic and microwave devices.

Learning Outcome:

Students will be able to understand

1. The current voltage characteristics of semiconductor devices.
2. The junction properties and breakdown mechanism.
3. The principle of diode and their application in today's world.
4. The transit time diodes and their working principle.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Review of Fundamentals of Semiconductors:** Semiconductor Materials and their properties, Carrier Concentration in Semiconductors: Fermi Level, Electron And Holes Concentration at Equilibrium, Temperature dependence of carrier concentration, Excess Carriers in Semiconductor, Optical Absorption, Absorption coefficient, Luminescence, Direct and Indirect Recombination, Carrier Lifetime and Photoconductivity, Photoconductor, Drift of carriers in an electric field, Effect of temperature and doping on mobility, Hall effect, Diffusion of carriers, Einstein Relation, The Continuity Equation, Diffusion length, The Haynes-Shockley Experiment.	30 Hours	1
II	**Junctions and Interfaces:** Description of p-n junction: The Contact Potential, Space charge at junction, Steady State condition in forward and reverse bias junction, Transient and AC conditions,	30 Hours	1

	Capacitance of PN junctions: Varacter Diode, Description of Breakdown Mechanism, Zener Breakdown, Avalanche Breakdown.		
III	**Special Diodes** Majority Carrier Diodes: The Tunnel Diode, The Schottky Barrier Diode, Semiconductor controlled rectifier (SCR), Microwave Diodes, The p-i-n Diode, The IMPATT Diode, TRAPATT Diode, Transferred Electron Devices (Gunn diode) Optoelectronic Devices: The Solar Cell, Photo detectors, Light Emitting Diodes, Semiconductor Lasers.	30 Hours	1
IV	**FET Transistors** Metal Semiconductor Field Effect Transistors: Basic Types of MESFET, Models for I-V Characteristics of Short Channel MESFETs, High Frequency Performance, MESFET Structures, MOS Transistors: Basic Structures and the Operating Principle, I-V Characteristics, Short-Channel Effects, MOSFET Structures, Charge Coupled Device.	30 Hours	1

Text Books:

1. M.S. Tyagi, "Introduction to Semiconductor Materials and Devices", John Willy-India Pvt. Ltd.
2. B. G. Streetman and S. Banerjee, "Solid state electronics devices", 5th Edition, PHI.

Reference Books:

1. S. M. Sze, "Physics of Semiconductor Devices", 2nd Edition, John Willy-India Pvt. Ltd.
2. Millman&Halkias, "Electronic Devices And circuits", TMH
3. Donald A. Neamen, "Semiconductor Physics And Devices", TMH

BEC2013 INTRODUCTION TO RADAR SYSTEMS

Course Objective:

1. To make students understand the basic concept of Radar.
2. To study the principle of Radar and different types of Radar.
3. To learn tracking with Radar.
4. To study about the detection of signals and propagation of Radar waves.
5. To study the concept of Navigation system through Radar.

Learning Outcome:

Students will be able to

1. Know the concept of Radar and its application.
2. Detect the Signal in Noise at Receiver.
3. Know about Radar system and its components.
4. Solve the problems related to the Range of Radar.
5. Know the concept of navigation system through Radar.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction to Radar** Basic Radar: Simple form of Radar Equation, Radar Block Diagram, Radar Frequencies, Applications of Radar, Detection of Signals in Noise: Receiver Noise, Signal to Noise Ratio, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar Cross-section of Targets, Radar Cross-Section Fluctuations, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters, System Losses.	30 Hours	1
II	**MTI , Pulse Doppler and Tracking Radar** Introduction to Doppler and MTI Radar: Doppler Frequency, Continuous Doppler Radar, Pulse Doppler Radar, MTI Radar, Delay Line Cancellers, Doppler Filter Banks, Digital MTI Processing, Limitations to MTI Performance, Moving Target Detector, Tracking with	30 Hours	1

	Radar: Mono pulse Tracking, Conical and Sequential Lobing, Low angle Tracking, Comparison of Trackers.		
III	**Radar Signal Detection and Information** Detection Criteria, Detectors, Automatic Detection, Constant False Alarm Rate Receivers, Basic Radar Measurements, Pulse Compression, Target Recognition, Clutter: Types of Clutter, Detection of Targets in Clutter, Basic of Radar Transmitter, Basic of Radar Receiver.	30 Hours	1
IV	**Propagation and Radar Navigation** Propagation of Radar Waves: Forward Scattering from a Flat Earth, Scattering from Round Earth's Surface, Basic of Standard and Non Standard Propagation, Diffraction and Attenuation, Other Propagation Effects, Directional Finder, Navigation System: Decca Navigation System, Tactical Air Navigation, Ground Controlled Approach.	30 Hours	1

Text Book:

1. Merrill I. Skolnik" Introduction to Radar Systems" Third Edition, McGraw Hill.
2. N.S. Nagaraja" Elements of Electronic Navigation" 2nd Edition, Tata McGraw Hill.

Reference Book:

1. J.C. Toomay , Paul J. Hannen " Principles of Radar" Third Edition.
2. NadavLevanon, *"RADAR Principles"*, John Wiley and Sons.

BEC2014 DATA STRUCTURE

Course Objective:

1. Familiarize the student with good programming design methods, particularly Top Down design.
2. Develop algorithms for manipulating stacks, queues, linked lists, trees, and graphs.
3. Develop the data structures for implementing the above algorithms.
4. Develop recursive algorithms as they apply to trees and graphs.
5. Familiarize the student with the issues of time complexity and examine various algorithms from this perspective.

Learning Outcome:

Student will

1. Be familiar with the use of data structures.
2. Be able to understand the differing logical relationships among various data items.
3. Understand the generic principles of computer programming as applied to sophisticated data structures.
4. Comprehend alternative implementations using the differing logical relationships.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction** Basic Terminology, Elementary Data Organization, Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic notations: Big-Oh, Time-Space trade-off. Abstract Data Types (ADT) Arrays: Definition, Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Application of arrays, Sparse Matrices and their representations. Linked lists: Array Implementation and Dynamic Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition, Generalized Linked List.	30 Hours	1

II	**Stacks and Queues** Stacks: Abstract Data Type, Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Recursion, Tower of Hanoi Problem, Simulating Recursion, Principles of recursion, Tail recursion, Removal of recursion Queues, Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues in C, De-queue and Priority Queue.	30 Hours	1
III	**Trees and Graphs:** Trees: Basic terminology, Binary Trees, Binary Tree Representation: Array Representation and Dynamic Representation, Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Array and Linked Representation of Binary trees, Tree Traversal algorithms: Inorder, Preorder and Postorder, Threaded Binary trees, Traversing Threaded Binary trees, Huffman algorithm. Graphs: Terminology, Sequential and linked Representations of Graphs: Adjacency Matrices, Adjacency List, Adjacency Multi list, Graph Traversal : Depth First Search and Breadth First Search, Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal algorithm. Transistive Closure and Shortest Path algorithm: Warshal Algorithm and Dijikstra Algorithm, Introduction to Activity Networks.	30 Hours	1
IV	**Searching and Sorting** Searching : Sequential search, Binary Search, Comparison and Analysis Internal Sorting: Insertion Sort, Selection, Bubble Sort, Quick Sort, Two Way Merge Sort, Heap Sort, Radix Sort, Practical consideration for Internal Sorting. Search Trees: Binary Search Trees (BST), Insertion and Deletion in BST, Complexity of Search Algorithm, AVL trees, Introduction to m-way Search Trees, B Trees & B+ Trees . Hashing: Hash Function,	30 Hours	1

	Collision Resolution Strategies Storage Management: Garbage Collection and Compaction.		

Text book:

1.Aaron M. Tenenbaum,YedidyahLangsam and Moshe J. Augenstein “Data Structures Using C and C++”, PHI Learning Private Limited, Delhi India

References:

1. Horowitz and Sahani, “Fundamentals of Data Structures”, Galgotia Publications Pvt Ltd Delhi India.
2. A.K. Sharma ,Data Structure Using C, Pearson Education India.
3. Rajesh K. Shukla, “Data Structure Using C and C++” Wiley Dreamtech Publication.

BEC2651 DIGITAL SIGNAL PROCESSING LAB

LIST OF EXPERIMENTS:

1. With the help of Fourier series, make a square wave from sine wave and cosine waves. Find out coefficient values.
2. Evaluate 4 point DFT of and IDFT of $x(n) = 1, 0 \leq n \leq 3; 0$ elsewhere.
3. Implement the FIR Filters for 2 KHz cutoff frequency and 2 KHz bandwidth for band pass filter.
4. Design FIR filter using Fourier series expansion method.
5. Implement IIR low pass filter for a 4 KHz cutoff frequency and compare it the FIR filter with the same type use chirp as input signal.
6. Verify Blackman and Hamming windowing techniques for square wave as an input which window will give good results.
7. Implement the filter functions.
8. Generate DTMF sequence 1234567890*# and observe its spectrogram.
9. Generate an Amplitude Modulation having side low frequencies 1200 Hz and 800 Hz. Observe and verify the theoretical FFT characteristics with the observed ones.
10. Generate Frequency Modulation having carrier frequencies 1 KHz and modulating frequency 200 Hz with the modulation index of 0.7. Observe and verify the theoretical FFT characteristics with the observed ones.
11. Generate an FSK wave form for transmitting the digital data of the given bit sequence. Predict and verify the FFT for the same one.
12. To study the circular convolution.

BEC2652 MICROWAVE LAB

List of Experiments:

1. Study of Reflex Klystron Characteristics.
2. Measurement of guide wavelength and frequency of the signal in a rectangular Waveguide using slotted line carriage in a Microwave Bench.
3. Measurement of impedance of an unknown load connected at the output end of the slotted line carriage in a Microwave Bench.
4. Determine the S-parameter of any three port Tee.
5. Determine the S-parameter of a Magic Tee.
6. Study various parameters of Isolator.
7. Measurement of attenuation of an attenuator and isolation, insertion loss, cross coupling of a circulator.
8. Determine coupling coefficient, insertion loss, directivity and isolation coefficient of anti Multi-Hole directional coupler.
9. To study working of MIC components like Microstrip Line, filter, directional Coupler, Wilkinson Power Divider, Ring resonator & coupler, antennas & amplifies.
10. Study of waveguide horn and its radiation pattern and determination of the beam width.

BEC2653 COMMUNICATION LAB - II

List of Experiments:

1. To construct a triangular wave with the help of Fundamental Frequency and its Harmonic component.
2. To construct a Square wave with the help of Fundamental Frequency and its Harmonic component.
3. Study Frequency Division Multiplexing (FDM) & De-multiplexing.
4. Study of Time Division Multiplexing (TDM) & De-multiplexing.
5. Study of Pulse code modulation (PCM) and its demodulation using Bread Board.
6. Study of delta modulation and demodulation and observe effect of slope overload.
7. Study of pulse data coding techniques for NRZ formats.
8. Study of Data decoding techniques for NRZ formats.
9. Study of Manchester coding and decoding.
10. Study of Amplitude shift keying modulator and demodulator.
11. Study of Frequency shift keying modulator and demodulator.
12. Study of Phase shift keying modulator and demodulator
13. Study of single bit error detection and correction using Hamming code.
14. Measuring the input impedance and Attenuation of a given transmission line.

BEC2701 OPTICAL COMMUNICATION

Course Objective:

This course provides comprehensive idea about

1. Principle and working of optical communication system.
2. Operation and characteristics of optical sources and detectors.
3. Optical Power and Link Design.

Learning Outcome:

At the end of the course students will be able to gain knowledge about the

1. Fundamentals of optical communication.
2. Advantages of optical communication over other means of communication.
3. Principles of optoelectronic devices.
4. Optical Link setup, WDM and OTDR.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Overview of Optical Communication** Introduction: Block diagram of optical fiber communication System: Advantages of optical fiber communication, Optical fiber wave guides, Ray theory transmission, Optical fiber Modes and configuration, Mode theory for circular Waveguides. Step Index fibers, Graded Index fibers. Single mode fiber: Mode Field Diameter, Effective Refractive Index. Fiber Material and its Fabrication Techniques.	30 Hours	1
II	**Optical Losses** Transmission Characteristics of Optical fiber: Attenuation in optical fibers, intrinsic and extrinsic absorption, linear and non linear scattering losses, Fiber bends losses, Dispersion and pulse broadening. Dispersion: Material dispersion, Wave-guide dispersion, Intermodal dispersion, intramodel dispersion. Optical fiber Connectors: Joints, Couplers and Isolators.	30 Hours	1

III	**Optical sources and Detectors** LEDs, Structures, Materials: Quantum efficiency, Power, Modulation, Power bandwidth product. Laser Diodes- Basic concepts, Classifications, Semiconductor injection Laser, Laser Modes, Threshold conditions, External quantum efficiency, Laser diode rate equations, resonant frequencies. Reliability of LED & ILD. Requirement for photo detections: PN photodiode, characteristics of photo detections, PIN and avalanche photodiodes, Comparison.	30 Hours	1
IV	**Optical Power and Link Design** Source to fiber power launching - Output patterns, Power coupling, Power launching: Equilibrium Numerical Aperture. Optical receiver operation- Fundamental receiver operation. Digital signal transmission, error sources. Receiver configuration: Digital receiver performance, Probability of error, Quantum limit, Analog receivers. Link Design: Point to Point Links, Power Penalties, Error control. Multichannel Transmission Techniques. WDM concepts and component overview. OTDR and Optical Power meter.	30 Hours	1

Text Books:

1. Govind P. Agrawal, “Fiber Optic Communication Systems”, John Wiley, 3rd Edition,2004.
2. John M. Senior, “Optical Fiber Communications”, PEARSON, 3rd Edition, 2010.

Reference Books:

1. Gerd Keiser, “Optical Fiber Communications”, TMH, 4th Edition, 2008.
2. Joseph C. Plais, “Fiber Optic Communication”, Pearson Education, 4th Ed, 2004

BEC2702 DATA COMMUNICATION NETWORKS

Course Objective:

1. To understand the concept of data communication and modulation techniques.
2. To comprehend the use of different types of transmission media and network devices.
3. To understand the error detection and correction in transmission of data.
4. To understand the concept of flow control, error control and LAN protocols.

Learning Outcome:

Students will

1. Learn OSI model.
2. Understand wireless LAN, IEEE 802 standard.
3. Know about the TCP/IP Protocol suite.
4. Learn Addressing, Sub netting and network layer protocols.
5. Know about application layer services.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**INTRODUCTION:** Network structure, Network architectures, The OSI reference model, Services and standardization, Connection oriented and connection less services. The Physical Layer: Transmission media, Pulse code modulation, FDM & TDM, Circuit switching, Packet switching, Hybrid switching, X.21, Ethernet.	30 Hours	1
II	**The Data Link Layer:** Basic link protocols, Character oriented and bit oriented protocols, The ALOHA protocols, IEEE standard 802 for LAN, Framing, Error control, Flow control.	30 Hours	1
III	**The Network Layer:** Design Issues. Routing Algorithms, Congestion control Algorithms, Subnet concept, Virtual circuit and Data	30 Hours	1

	gram Subnet, Flow control, Internetworking, Bridges, Routers, Gateways and different level switches.		
IV	**The Transport Layer:** Design Issues, Connection management, Study of Internet and ATM transport layer protocols, Internet Issues: Principles of bridges and routers. The TCP/IP Protocol suite: Overview of TCP/IP. Addressing, Subnetting and network layer protocols. Application layer services: DNS, DHCP, FTP, TFTP, SMTP, SNMP, HTTP, WWW.	30 Hours	1

Text Book:

1. B.A. Forouzan, "Data Communication and Networking", Tata McGraw Hill.

References:

1. William Stallings: Data & Computer Communication, Prentice Hall.
2. Andrew S. Tanenbaum: Computer Networks, PHI India.
3. Leon-Garcia,Widjaja: Communication Networks, TMH.

Generic Elective -II

BEC2021 SATELLITE COMMUNICATION

Course Objective:

1. To study the basic concept of Satellite communication.
2. Knowing the various aspects like orbital mechanics, launching techniques and link design.
3. To study the earth station technology and different access system.
4. To study about Propagation effect in Satellite Communication.
5. To study about different types of Satellite Services.

Learning Outcome:

1. Students will gain knowledge in orbital aspects involved in satellite communication.
2. Analyze link budget of satellite signal for proper communication.
3. Ability to know how to place a satellite in an orbit.
4. Ability to calculate the basic parameters in satellite communication.
5. Use the different applications of Satellite services.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Elements of Satellite Communication** Overview of Satellite Communication, Frequency Allocation for Satellite Communication, Kepler's Law, Definition of terms for Earth Orbiting Satellite: Apogee and Perigee Heights, Look Angle Determination. Orbital Perturbations, Launches and Launch Vehicles, Orbital Effects in Communication Systems Performance.	30 Hours	1
II	**Satellite Subsystems** Attitude and Orbit Control System, Telemetry, Tracking, Command and Monitoring, Power System, Communication Subsystems: Description, Transponders. Satellite Antennas.	30 Hours	1

III	**Link Design and Propagation Effect** Factors effecting Satellite Design, Basic Transmission Theory: Link Power Budget Equation. System Noise Temperature and G/T Ratio. Uplink Design: Input Backoff. Downlink Design: Output Backoff. Equipments for Earth Stations: LNA, HPA, FDM System, TDM System. Attenuation and Depolarization, Atmospheric Absorption, Rain and Ice Effect.	30 Hours	1
IV	**Satellite Services** VSAT: Network Architecture, Access Control Protocol, Basic Technique, VSAT Earth Station. Direct Broadcast Satellite: Digital DBS TV, Error Control and Master Control Station. Global Positioning System: Principle of GPS, GPS Receivers and Codes. Satellite Signal Acquisition	30 Hours	1

Text Book :

1. B. Pratt, A. Bostian, "Satellite Communications", Wiley India.
2. D. Roddy, "Satellite Communications", TMH, 4th Ed.

Reference Book:

1. S. D. Ilcev, "Global Mobile Satellite Communication", Springer
2. R. Pandya, "Mobile and Personal Communication Systems and Services ", PHI.

BEC2022 TELECOM NETWORK MANAGEMENT

Course Objective:

1. To familiarize the student with the design of modern data communications networks.
2. To analyze the operation and management of communications networks.
3. To provide knowledge of types of communications network systems and their strengths and limitations.

Learning Outcome:

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

1. Understand the fundamental principles and technical standards.
2. Understand basics of telecommunication, networking and information technologies.
3. Learn and implement network informative systems.
4. Study the emerging technology and technical advancement in network management.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Overview of Network Management** Case histories on network, system and service management, challenges of IT managers, Network Management: Goals, organization and functions, Network management architecture and organization network management perspectives. **OSI Network Management** Network management standards, Network management models, Organization model, Information model, Communication model and functional model, Abstract syntax notation – encoding structure, macros functional model CMIP/CMISE.	30	1
II	**Internet Management (SNMP)** SNMP-organizational model, System overview,	30	1

	Information model, communication model, functional model, SNMP proxy server, Management information, Protocol remote monitoring- RMON.		
III	**Broadband Network Management** Broadband networks and services, ATM Technology – VP, VC, ATM Packet, Integrated service, ATM LAN emulation, Virtual LAN. ATM Network Management – ATM network reference model, Integrated local management interface. ATM management information base, role of SNMP and ILMI in ATM management. M1, M2, M3, M4 interface. ATM digital exchange interface management.	30	1
IV	**Network Management Applications** Configuration management, Fault management, Level management, Fault management, Event correlation techniques, Security management, Accounting management, report management, policy based management services, Level management. **Telecommunication Management Networks(TMN)** Need for TMN, Conceptual model, TMN standards, TMN management services architecture and TMN implementation.	30	1

Text Books:

1. Mani Subramaniam, *—Network Management Principles and Practise"*, Addison Wisely, New York, 2000.
2. Lakshmi G. Raman, *— Fundamental of Telecommunications Network Management"* Eastern Economy Edition, IEEE Press New Delhi.

Reference Books:

1. Salh Aiidarons, Thomas Plevoyak *—Telecommunications Network Technologies and implementations"* Eastern Economy Edition, IEEE press New Delhi-1998.
2. Voice over IP- Uyless Black- Prentice Hall series in Advanced Communication Technologies.

BEC2023 INTRODUCTION TO OPTOELECTRONICS

Course Objective:

Course gives the comprehensive idea about

1. The principle of electro optic effect.
2. Optical processing, Optical sensors and Optical modulators as well as their working.
3. Optical wave guide, Optical computing and arithmetic operations.

Learning Outcome:

At the end of the course students will be able to gain knowledge about

1. Performance of optical modulators and optical sensors.
2. Different type of optical sensor operation.
3. Optical computing and their arithmetic.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction and Electro optic effect** Introduction to Optical waveguide, Photo sources, Photo detectors, Optical waveguide modes, Theory of dielectric slab waveguides, Symmetric & Asymmetric slab wave guide, Birefringence phenomenon, Electro optic Retardation, Electro optic amplitude, Phase modulator, Electro optic intensity modulators, Beam deflection, Acousto –optics, acousto –optics modulators, Integrated optic spectrum analyzer, Non linear optics second harmonic generation, Parametric amplification.	30 Hours	1
II	**Fourier Optics** Phase transformation of thin lens, Fourier transforming property of Lens, Image forming property of Lens, Interferometer, Optical data storage, Speckle Phenomenon, Laser Interferometer.	30 Hours	1
III	**Optical Fiber Sensors** Multimode fiber Sensors: Displacement, pressure, stress,		

	strain. Intensity modulated sensors, Active multimode fiber optics sensors, Micro-bend optical fiber sensor, Magnetic sensors, Single mode fiber, optics sensors, Polarization modulated sensors, Fiber optic Gyroscope.	30 Hours	1
IV	**Optical Computing and Arithmetic Operations** Analog linear optical processing, Halftone processing, Non linear processing, Analog arithmetic operation: Addition, Subtraction, Multiplication, Division, Averaging, Differentiation and integration. Digital Logic: Modified signed digit number system, Residue Number system, Logarithmic number system. Arithmetic Operation: Residue, Signed logarithmic arithmetic, Threshold logic, Threshold devices, Spatial light Modulators, Theta Modulation devices.	30 Hours	1

Text Books:

1. Mohammad A.Karim ,Abdul As Awwal , "Optical Computing –An introduction", Wiley, Reprint 1992.
2. F.T.S. Yu, "Optical Information Processing", John Wiley, New York, Reprint 1983.

Reference Books:

1. J. Wilson, J.F.B. Hawkes k, "*Opto Electronics: An Introduction*", PHI, Second Edition Reprint 2000.
2. I.P. Kaminov , "*A Introduction to Electro Optic Devices*",Academic Press New York, Reprint 1974.
3. A Yariv , " *Optical Electronics*",C.B.S. Collage Publishing, New York, Reprint 1985.

BEC 2024 NETWORK SECURITY

Course Objective:

The objectives of this course are to:

1. Extensive, detailed and critical understanding of the concepts, issues, principles and theories of computer network security.
2. Detailed and practical understanding of formalisms for specifying security related properties and validating them by using model checking.
3. Critical theoretical and detailed practical knowledge of a range of computer network security technologies as well as network security tools and services.
4. Practical experience of analyzing, designing, implementing and validating solutions to computer network security challenges using common network security tools and formal methods.

Learning Outcome:

Students will gain knowledge about:

1. Fundamental concepts of computer security.
2. Basic concepts of symmetric & asymmetric cryptography.
3. Fundamental concepts of different digital signature schemes identity security weaknesses in different networking environment.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction to Cryptography** Introduction to security attacks, services and mechanism, introduction to cryptography. Conventional Encryption: Conventional encryption model, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers. Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, fiestal structure, data encryption standard(DES), strength of DES, differential and linear crypt analysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, confidentiality using	30 Hours	1

	conventional encryption, traffic confidentiality, key distribution, random number generation.		
II	**Algorithm for encryption** Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms. Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffle-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elganel encryption.	30 Hours	1
III	**Authentication & Digital Signatures** Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA). Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.	30 Hours	1
IV	**Authentication Applications & IP Security** Authentication Applications: Kerberos and X.509, directory authentication service, electronic mail security-pretty good privacy (PGP), S/MIME. IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. Web Security: Secure socket layer and transport layer security, secure electronic transaction (SET). System Security: Intruders, Viruses and related threads, firewall design principals, trusted systems.	30 Hours	1

Text / Reference books:

1. William Stallings, “Cryptography and Network Security: Principals and Practice”, Prentice Hall, New Jersy.
2. Johannes A. Buchmann, “Introduction to Cryptography”, Springer-Verlag.
3. Bruce Schiener, “Applied Cryptography”.

Generic Elective – III

BEC2031 VLSI DESIGN

Course Objective:

1. To teach fundamentals of VLSI circuit design and implementation using circuit simulators and layout editors.
2. To highlight the circuit design issues in the context of VLSI design.
3. To demonstrate a clear understanding of CMOS fabrication flow and technology scaling.

Learning Outcome:

1. To design MOSFET based logic circuit.
2. To draw layout of a given logic circuit.
3. To realize logic circuits with different design styles.
4. To understand the working principle and operation of different types of memories.
5. To understand the working principles of clocking, power reduction and distribution.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Overview of VLSI Design Methodologies** VLSI Design Flow, Design Hierarchy, Concepts of Regularity, Modularity and Locality. MOSFET Fabrication: Fabrication process flow, NMOS and CMOS fabrication, Layout design rules, Stick diagram and mask layout design. MOS Transistor: MOS Structure, The MOS System under external bias, Operation of MOSFET, MOSFET - Current / Voltage Characteristics, Scaling and Small geometry effects and capacitances.	30 Hours	1
II	**CMOS Technology** MOS Inverters: Introduction, Resistive Load Inverter,	30 Hours	1

	Inverters with n-type MOSFET load, CMOS Inverter. MOS Inverters - Switching Characteristics, Delay – Time Definitions, Calculation of Delay Times, Inverter Design with Delay Constraints. Combinational MOS Logic Circuits: Introduction, MOS logic circuits with depletion NMOS Loads.		
III	**CMOS logic circuits & Memory** CMOS logic circuits, Complex logic circuits. CMOS transmission gates (pass gates) Sequential MOS Logic Circuits: Introduction, Behavior bistable elements, SR latch circuits, Clocked latch and FF circuits, CMOS D latch and edge triggered FF. Dynamic logic circuits: Introduction, Basic principle of pass transistor circuits, Synchronous dynamic circuit techniques, Dynamic CMOS circuit techniques, Domino CMOS logic. Semiconductor memories: Introduction, DRAM, SRAM, ROM, flash memory.	30 Hours	1
IV	**Low power CMOS Logic Circuits and Testing** Low power CMOS Logic Circuits: Introduction, Overview of Power Consumption, Low – Power Design through voltage scaling, Estimation and Optimization of switching activity, Reduction of Switched Capacitance and Adiabatic Logic Circuits. Design for Testability: Introduction, Fault Types and Models, Controllability and Observability, Ad Hoc Testable Design Techniques, Scan Based and BIST Techniques.	30 Hours	1

Text Book:

1. Sung-Mo Kang &Yosuf Leblebici, “CMOS Digital Integrated Circuits: Analysis & Design”, TMH, 3rd Edition.

Reference Books:

1. D. A. Pucknell and K. Eshraghian, “Basic VLSI Design: Systems and Circuits”, PHI, 3rd Ed., 1994.
2. W.Wolf, Modern VLSI Design: System on Chip, Third Edition, Pearson, 2002.

BEC2032 MICROWAVE INTEGRATED CIRCUIT DESIGN

Course Objective:

1. To study the Integration of microwave devices in the form of IC.
2. To study the Fabrication of MIC.
3. To understand the advance applications of microwave engineering.
4. To design the transistor and oscillators for various applications.
5. To design different types of amplifier.

Learning Outcome:

1. Ability to design microwave integrated circuit.
2. Ability to design and implement microwave amplifier, transistor and oscillator.
3. Ability to design and implement the various layouts.
4. Ability to solve the equivalent circuit of various microwave devices.
5. Analyze the stability criteria and various parameters of MIC.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Microwaves Integrated Circuits Components** Lumped elements for MIC: Design of lumped elements, Design of inductance, capacitance and resistance. Resonators: Resonator parameters, Resonant frequency, Quality factor, Rectangular micro strip resonator. Hybrids and couplers: Basics of hybrids and couplers, Types of hybrids and couplers, Design of hybrids, Directional couplers using aperture coupled lines.	30 Hours	1
II	**Fabrication of MMC's/MMIC'sand Transmission Lines** Introduction, Materials, Mask layouts and mask fabrication, Hybrid MIC, Mimics- design considerations, Design procedures and MMIC fabrication, Hybrid versus Mimics, Various planar transmission lines for MICs, Design of various transmission lines.	30 Hours	1
III	**Active and Passive Microwave Devices**	30 Hours	1

	Microwave transistor: Equivalent circuit. Basic operation principles of FET, Power FETs, MESFET model: Introduction, Equivalent circuit. Figure of merit: Schottky barrier junctions, Varactor diodes, Step recovery diodes, PIN diodes.		
IV	**Microwave Semiconductor Sources and Amplifiers** Oscillators: Introduction, Concept of negative resistance, Oscillation, and stability conditions, Design of fixed frequency oscillators. Amplifiers, Two port representation of transistor, Stability consideration, Amplifier characterization. Non-linear behaviour, Biasing networks, Linear amplifier design, Three port S-parameter characterization of transistors.	30 Hours	1

Text Book:

1. D. Vendelin, A. M. Pavio, and U. L. Rohde, Microwave Circuit Design, John Wiley & Sons Publication.
2. I. J. Bahl and P. Bhartia, "Microwave solid state circuit design", John Wiley and Sons.

Reference Book:

1. D. H. Schrader, ―Microstrip Circuit Analysis, Prentice Hall PTR, New Jersey
2. K. C. Gupta, R. Garg, and I. J. Bahl, ―Microstrip Lines and Slot Lines‖, Artech House

BEC2033 EMBEDDED SYSTEMS

Course Objective:

1. To provide the basics of embedded system.
2. To study the designing of embedded system with microcontrollers.
3. To introduce designing using Real time OS.
4. To introduce various software development tools.

Learning Outcome:

Student will learn

1. The basics of embedded system.
2. Designing of embedded system with microcontrollers.
3. Designing using Real time OS.
4. Various software development tools.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction to embedded systems** History of Embedded Systems, Classification of embedded system, Major application and areas of embedded system, Innovative bonding of life style with embedded technology. Typical embedded system: Core of embedded system, Memory, Sensors and actuators, communication interface, Embedded firmware, PCB and passive components, Characteristics of embedded system, Quality attributes of embedded system.	30 Hours	1
II	**Designing embedded system with microcontroller** Factors to be considered in selecting controller, 8051 microcontroller, Designing with 8051, 8052 microcontroller, Addressing modes supported by microcontroller, 8051 instruction set, Fundamental issues in Hardware software co design, computational models in embedded Design, Introduction to unified modeling language, Hardware software trade off.	30 Hours	1
III	**Basic design using real time operating system** Introduction to real time operating system: Task and Task	30 Hours	1

	state, Task and Data, Semaphores and shared data. Design of RTOS: Encapsulating Semaphores and queues, Hard real time Scheduling memory space, Saving power.		
IV	**Embedded Software development tools** Host and target machines, linker / locators for embedded software, Getting embedded software in to target system, Debugging techniques, Testing on your host machines, Instruction set Simulator, Assert macro, Using laboratory tools.	30 Hours	1

Text Books:

1. An Embedded Software Primer-David E Simon,Pearson,1999
2. Shibu K V ,"Introduction to Embedded Systems",TMH

Reference books:

1. H.Kopetz,"Real Time Systems",Kluwer

BEC2034 ANALOG SIGNAL PROCESSING

Course Objective:

1. To study Linear Analog Function such as Addition, Subtraction, Differentiation and Integration.
2. To study the concept of AC/DC signal conversion.
3. To study Non- Linear Analog Function.
4. To design and analyse the Continuous time Op-amp RC filters.
5. To give overview of Tran conductance-C filters.

Learning Outcome:

This course enables the students to

1. Implement different Linear Analog Function.
2. Understand the AC/DC signal Conversion.
3. Apply the basic fundamental of Non-Linear Analog Function.
4. Design and implement the Continuous time Op-amp RC filters.
5. Design Tran conductance-C filters.that perform the desired operations.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Linear Analog Functions and AC/DC Signal Conversion: Addition, Subtraction, Differentiation and Integration, Impedance Transformation and Conversion, Signal Rectification, Peak and Valley Detection, RMS to DC Conversion, Amplitude Demodulation.	30	1
II	Nonlinear Analog Functions: Voltage Comparison, Voltage Limiting (Clipping), Logarithmic Amplifiers, Analog Multipliers, Analog Dividers.	30	1
III	Continuous time Op-amp RC filters: Second order LP, HP, BP, Notch and AP transfer functions, Kirwin-Huelsman-Newcomb biquad, Ackerberg-Mosberg Circuits, Tow-Thomas biquad, compensated integrators, Sallenkey Circuits, Generalized convertor, GIC biquads.	30	1
IV	Transconductance-C filters: Transconductance Cells, Realization of Resistors, Amplifiers and Gyrators, First	30	1

	order and Second Order Sections, Ladder design.		

Text/Reference Books:

1. Ramon Pallas-Areny, John G. Webster, “Analog Signal Processing”, John Wiley& Sons.

2. R. Schaumann and M. E. Valkenberg, “Design of Analog Circuits”, Oxford University Press, 2001

BEC2751 CAD OF ELECTRONICS LAB

1. (a) Transient Analysis of BJT inverter using step input.

   (b) DC Analysis (VTC) of BJT inverter with and without parameters.

2. (a) Transient Analysis of MOS inverter using step input.

   (b) Transient Analysis of NMOS inverter using pulse input.

   (c) DC Analysis (VTC) of NMOS inverter with and without parameters.

3. (a) Analysis of CMOS inverter using step input.

   (b) Transient Analysis of CMOS inverter using step input with parameters.

   (c) Transient Analysis of CMOS inverter using pulse input.

   (d) Transient Analysis of CMOS inverter using pulse input with parameters.

   (e) DC Analysis (VTC) of CMOS inverter with and without parameters.

4. Transient & DC Analysis of NOR Gate inverter.

5. Transient & DC Analysis of NAND Gate.

6. Synthesis and simulation of Full Adder.

7. Synthesis and Simulation of Full Subtractor.

8. Synthesis and Simulation of 3 X 8 Decoder.

9. Synthesis and Simulation of 8 X 1 Multiplexer.

BEC2752 ELECTRONICS CIRCUIT DESIGN LAB

In this practical course students will carry out a design oriented project work using various analog/ digital building blocks which they have already studied in their analog electronic/digital electronic courses such as Electronic circuits, integrated circuits and filter design. The project may include but not restricted to any of the following:

1. Universal op-amp based biquad.

2. Universal OTA biquad.

3. Amplitude control or stabilization applied to any sinusoidal oscillators.

4. Op-amp/ OTA based function generator.

5. Any application of log/antilog circuits.

6. Any applications of analog multiplier/ divider.

7. Any digital system design and its hardware implementation using TTL/ CMOS ICs.

8. Any circuit idea (not studied in the course) using 555 Timer in conjunction with any other ICs.

The above must include

1. Design the circuit.

2. Make hardware and measure various parameters.

3. Simulation in Spice of the designed circuit.

4. Comparison of measured and simulated results.

5. A report is to be made for evaluation.

BEC2801 WIRELESS COMMUNICATION

Course Outcome:

1. To study the concept of wireless communication and mobile radio propagation.
2. To study various modulation and multiple access techniques.
3. To know about diversity and equalization.
4. To study cellular system design.
5. To know the mobile communication evolution of 2G and 3G.
6. To have overview of immerging technologies for Wireless standards.

Learning Outcome:

1. Student will learn basics of wireless communication and spread spectrum techniques.
2. Student will learn large scale path loss and various small scales fading.
3. Understand evolution of mobile communication generations 2G, 2.5G, 3G with their characteristics and limitations.
4. Understand different indoor and outdoor propagation models related to losses and different types of fading.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction to Wireless Communication System and Mobile Radio Communication.** Evolution of mobile radio communication fundamentals, Large scale path loss: Propagation models, Reflection, Diffraction, Scattering, Practical link budget design using path loss model. Small scale fading. Multipath propagation and measurements. Impulse response model. Parameters of multipath channels, Types of small scale fading, Theory of multi-path shape factor for fading wireless channels.	30 Hours	1
II	**Modulation Techniques, Equalization, Diversity.** Spread spectrum modulation techniques: Pseudo-noise sequence, Direct sequence spread spectrum (DS-SS),	30 Hours	1

	Frequency hopped spread spectrum(FH-SS), Performance of DS-SS, Performance of FH-SS. Modulation performance in fading and multipath channels. Fundamentals of equalization: Equaliser in communication receiver, Survey of equalisation techniques, Linear equalizer, Non-linear equalization. Diversity techniques. RAKE receiver.		
III	**Speech Coding and Multiple Access Techniques** Characteristics of speech signals, Quantization techniques, Vocoders, Linear predictive coders, Introduction to multiple access: Time division multiple access, Space division multiple access, Frequency division multiple access.	30 Hours	1
IV	**The Cellular Concept, Wireless networks and Standards.** Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage and capacity in cellular systems, Introduction to wireless networks, 2G, 3G wireless systems, Wireless standards.	30 Hours	1

Text Book:

1. T.S. Rappaport, “Wireless Communication-Principles and practice”, Pearson

Reference Books:

1. Willium C. Y. Lee, “Mobile communication Design and fundamentals”
2. D. R. KamiloFehar, “Wireless digital communication”
3. Haykin S &Moher M., “Modern wireless communication”, Pearson, 2005

Generic Elective - IV

BEC2041 OPTICAL NETWORKS

Course Objective:

1. To study coverage of the basic principles of optical networks and its components.
2. To study about different types of optical networks.
3. To study the concept of Wavelength Division Multiplexing (WDM) schemes.
4. To study the different types of protection schemes in optical network.
5. To study the various types of switching and other mechanism used in optical network.

Learning Outcome:

This course enables the students to

1. Understand the fundamental principles of light wave in optical network.
2. Identify structures, functions, materials, and working principle of light sources, couplers, detectors, and multiplexers
3. Design optical fiber communication links using appropriate optical fibers, light sources, couplers, detectors, and multiplexers.
4. Understand the various issues in designing of WDM networks.
5. Conceptualize the Packet switched network (PPS) capable of providing packet switched services at the optical layer.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction to Optical Networks and its component** Principles of Optical Network and its Generation, Characteristics of Optical Fiber: Self-Phase Modulation, Cross-Phase Modulation, Four-Wave Mixing.Optical Packet Switching, Transmission Basics, Multiplexers & Filters: Gratings- Bragg Grating, Fiber Grating, Fabry-Perot Filters, Mach-Zehnder Interferometers, ArrayedWaveguideGrating. Optical Amplifiers, Tunable Lasers, Switches, Wavelength Converters, Introduction to soliton systems.	30	1

II	**Networks** Synchronous Optical Network(SONET) / Synchronous Digital Hierarchy (SDH)- Introduction, SONET/SDH Multiplexing, SONET/ SDH Layers and Frame Structure, Elements of a SONET/SDH Infrastructure. Optical Transport Network, Generic Framing Procedure, Internet Protocol, Ethernet, Wave Division Multiplexing (WDM) Network Elements: Optical Line Terminals, Optical Line Amplifiers, Optical Add/ Drop Multiplexers, Optical Crossconnects.	30	1
III	**WDM Network Design, Survivability and Introduction to Access Network** WDM Network Design: Cost Trade-offs, Light path Topology Design, Routing and wavelength assignment problems, Wavelength Conversion. Network Survivability: Basic Concepts, Protection in SONET/SDH, Protection in client layer, Optical Layer Protection, Interworking between Layers. Access Networks: Network Architecture Overview, Enhanced HFC, FTTC, PON evolution	30	1
IV	**Optical Switching and Deployment Considerations** Optical Tme Division Multiplexing (OTDM): Synchronization, Header Processing, Buffering (Output and Input Buffering), Burst Switching. Deployment Considerations: SONET/SDH core Network, Architectural Choices for Next-Generation Transport Networks.	30	1

Text Books:

1. R. Ramaswami, & K. N. Sivarajan, "Optical Networks a Practical Perspective", Morgan Kaufmann Publishers, 3rd Ed.
2. U. Black, "Optical Networks: Third Generation Transport Systems" PearsonEducations.

Reference Books:

1. Biswanath Mukherjee "Optical WDM Networks" Springer Pub 2006.
2. Murthy, C. Siva Ram &Gurusamy, Mohan "WDM Optical Networks Concepts, Design & Algorithms" / Prentice Hall (India)
3. Keiser, "Optical Fiber Communication Systems", 4th edition, TMH.

BEC2042 ULTRA WIDEBAND COMMUNICATION

Course Objective:

1. To focuses on the basic techniques that concerns present and future dynamic UWB communication systems.
2. To encompass all areas of design and implementation of UWB systems.
3. To develop a comprehensive overview of UWB system design that spans propagation, transmit and receive antenna implementations, standards and advanced topics, modulation and multiple access, network issues, and applications.

Learning Outcome:

This course enables the students to

1. Understand nuances of planning and design of RF network.
2. Work professionally in the area of Antenna design and Radio Propagation.
3. Apply the knowledge of mathematics and engineering to solve practical EM engineering problems.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction** UWB BASICS, Regulatory bodies, UWB signals and systems with UWB waveforms, Power spectral density, Pulse shape, Pulse trains, Spectral masks, Multipath, penetration characteristics, spatial and spectral capacities – speed of data transmission, Gaussian waveforms, Designing waveforms for specific spectral masks.	30	1
II	**Signal Processing Techniques For UWB Systems And UWB Channel Modeling** Effects of lossy medium on UWB transmitted signal , Time domain analysis, frequency domain analysis, Detection and Amplification, Two ray UWB propagation model, Frequency domain auto regressive model, IEEE proposals for UWB channel models.	30	1

III	**UWB Communications** UWB modulation methods, pulse trains, UWB transmitter/receiver, Multiple access techniques in UWB and capacity of UWB systems.	30	1
IV	**UWB Antennas and Arrays, Position and Location with UWB Signals** Antenna fundamentals: Antenna radiation for UWB signals, Conventional antennas and Impulse antennas for UWB systems, Beam forming for UWB signals: radar UWB array systems, Wireless positioning and location: GPS techniques, Positioning techniques, Time resolution issues, UWB positioning and communications.	30	1

Text/ Reference Books:

1. M. Ghavami, L. B. Michael and R. Kohno, ―*Ultra Wideband Signals and Systems In Communication Engineering*‖, 2nd Edition, John Wiley & Sons, NY, USA, 2007.
2. Jeffrey H. Reed, ―*An Introduction To Ultra Wideband Communication Systems*‖, Prentice Hall Inc., NJ, USA, 2005.
3. Ian Oppermann, Matti Hamalainen and Jari Iinatti ―*UWB Theory and Applications*‖, John Wiley & Sons Ltd, 2004

BEC2043 INFORMATION THEORY AND CODING

Course Objective:

1. Understand the difference between "data" and "information" in a message.
2. Learn how to analyze and measure the information per symbol emitted from a source**.**
3. Learn how to analyze the information-carrying capacity of the communication channel.
4. Learn how to design source compression codes to improve the efficiency of information transmission.
5. Learn how to adapt and tailor known error control codes for use in particular applications.
6. Learn the basic theory needed for data encryptions.

Learning Outcome:

1. The student will understand the basics of information theory and coding techniques.
2. The student will determine the minimum number of bits per symbol required to represent the source and the maximum rate at which a reliable communication can take place over the channel.
3. The student will learn about cyclic codes.
4. The student will understand the concept of convolution codes, their encoding as well as decoding.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Information Theory and Source Coding** Definition of Information: Entropy, Information Rate, Discrete, Memory less Channel, Mutual Information, Channel Capacity, Shannon's Theorem, Shannon-Fano Algorithm, Huffman Coding.	30 Hours	1
II	**Linear Block Codes** Introduction to Error Control Coding, Error Detection: Redundancy, Parity Check, Cyclic Redundancy Check	30 Hours	1

	(CRC), Checksum. Error Correction: Automatic Repeat Request (ARQ), Forward Error Correction (FEC). Hamming Code.		
III	**Cyclic Codes** Polynomial representation of code words, Generator polynomial of a cyclic code, Cyclic codes in systematic format, Generator Matrix of a cyclic code, Encoder for a cyclic code, Decoding of a cyclic code.	30 Hours	1
IV	**Convolutional Codes** Introduction, Convolutional Encoder Representations: Representation of Connections, State Diagram Representation, Trellis Representation. Decoding: Viterbi Algorithm, Sequential Decoding.	30 Hours	1

Text Books:

1. J. C. Moreira & P.G. Farrell, "Essentials of Error Correcting Codes" John Wiley
2. Communication Systems: Analog and Digital, R Singh,S. Sapre, McGraw Hill

Reference Books:

1. Robert G. Gallagar, "Information Theory And Reliable Communication", John Wiley.
2. Simon Haykin , "Digital Communication" , John Wiley , Fourth Edition, Reprint 2009.
3. B.P Lathi, "Modern Digital & Analog Communication Systems", Oxford University Press, Fourth Edition, 2010.
4. Taub& Schilling, "Principles of Communication Systems", TMH.

BEC2044 ARTIFICIAL NEURAL NETWORK

Course Objective:

The objectives of this course are to:

1. Understand the role of neural networks in engineering, artificial intelligence, and cognitive modeling.
2. Provide knowledge of supervised learning in neural networks.
3. Provide knowledge of computation and dynamical systems using neural networks.
4. Provide knowledge of reinforcement learning using neural networks.

Learning Outcome:

1. Feed-forward neural networks of increasing complexity, gradient descent learning and extensions, learning and generalization theory.
2. Have an understanding of the concepts and techniques of neural networks through the study of the most important neural network models.
3. Be able to apply neural networks to particular applications, and to know what steps to take to improve performance.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction and history, human brain, biological neuron, models of neuron, signal flow graph of neuron, feedback, network architecture, knowledge representation, Artificial intelligence and neural networks. Learning Process Error correction learning, memory based learning, Hebbian learning, competitive learning, Boltzmann learning, learning with and without teacher, learning tasks, memory and adaptation.	30 Hours	1
II	Artificial neurons, Neural networks and architectures Introduction, neuron signal function, mathematical preliminaries, Feed forward & feedback architecture. Geometry of Binary threshold neurons and their networks Pattern recognition, convex sets and convex hulls, space of Boolean functions, binary neurons for pattern classification, non linear separable problems, capacity of TLN, XOR solution. Perceptrons and LMS Learning	30 Hours	1

	objective of TLN, pattern space & weight space, perceptron learning algorithm, perceptron convergence theorem, pocket algorithm, α – LMS learning, MSE error surface, steepest descent search, μ – LMS and application. Backpropogation and other learning algorithms. Multilayered architecture, backpropagation learning algorithm, practical considerations, structure growing algorithms, applications of FFNN, reinforcement learning.		
III	Statistical Pattern Recognition Bayes' theorem, classical decisions with bayes' theorem, probabilistic interpretation of neuron function, interpreting neuron signals as probabilities, multilayered networks & posterior probabilities, error functions for classification problems. RBF Networks Regularization networks, generalized RBF networks, RBF network for solving XOR problem, comparison of RBF networks & multilayer perceptrons. Stochastic Machines Statistical mechanics, simulated annealing, Boltzmann machine.	30 Hours	1
IV	Adaptive Resonance Theory Building blocks of adaptive resonance, ART 1. Self Organizing Feature MAP Introduction, Maximal eigenvector filtering, principal component analysis, generalized learning laws, competitive learning, vector quantization, maxican hat networks, SOFM, applications of SOFM.	30 Hours	1

Text/ Reference Books:

1. Simon Haykin, "Neural Networks,", Pearson Education 2nd edition.
2. Satish Kumar, "Neural Networks," Tata McGraw-Hill.
3. Jack M. Zurada, " Introduction to Artificial Neural System," Jaico Publishing House.

Generic Elective - V

BEC2051 ELECTRONICS SWITCHING

Course Objective:

1. To learn about principles of telecommunication switching.
2. To learn about working of electronic switching system based on time division switching and space division switching.
3. To understand the problem of congestion, blocking probability for the designing of switching system.
4. To understand about telephone network and data network and also about the interdependency of both networks.

Learning Outcome:

1. Students will learn basics of switching system.
2. Students will learn space division switching and time division switching.
3. Students will learn about telecom traffic engineering.
4. Students will learn about telephone networks and data networks.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Evolution of switching system** Introduction: Simple telephone communication. Basics of switching system: Signaling tones, Strowger switching components, Crossbar switching system, Cross point technology, Touch tone dial telephone.	30 Hours	1
II	**Space division switching and Time division switching** Space division switching, SPC, Centralized SPC, Distributed SPC. Time division switching: Basic time division space switching, Basic time division time switching, Comparison of single stage and multistage network, Enhanced services.	30 Hours	1
III	**Telecom Traffic Engineering** Introduction: Network traffic load and parameters, Grade	30 Hours	1

	of service and blocking probability, Modeling switching systems, Incoming traffic and service time characterization, Blocking models and loss estimates, Delay systems.		
IV	**Telephone networks and Data networks** Telephone networks: Subscriber loop system, Switching hierarchy and routing, Numbering plan, Charging plan, Signaling techniques, Common channel signaling, Data networks, Data transmission in PSTN, Switching techniques for data transmission, Circuit switching, Store and forward switching, ISO-OSI model.	30 Hours	1

Text books:

1. ThiagarajanViswanathan, "Telecommunication switching System and networks", PHI.

Reference Books:

1. J.C. Bellamy, "Digital Telephony", John Wiley, 3rd Ed.
2. J.E. Flood, "Telecommunication switching, Traffic and Networks", Pearson education.

BEC2052 TELEVISION ENGINEERING

Course Objective:

1. To study fundamental of television engineering.

2. To study television picture tubes, cameras and its broadcasting.

3. To study television receivers and circuits.

4. To study transmission and reception of color television.

Learning Outcome:

1. Students to have knowledge of basic concepts of television engineering.

2. To study characteristics of picture tubes and cameras.

3. Understand television receivers and its circuits.

4. Understand working of a colour television.

Course Contents:

Module	**Course Topics**	**Total Hours**	**Credits**
I	**Fundamentals of Television Engineering** Elements of Television system: Picture Transmission and reception, Sound Transmission and reception, Receiver controls, Analysis and Synthesis of Television Pictures: Gross Structure, Image Continuity, Number of scanning lines, Flicker, Fine Structure, Tonal Gradation, Composite Video Signals: Video Signal Dimensions, Horizontal and Vertical Sync details, Scanning sequence details, Functions of vertical pulse trains, Sync details of 525 line system, Signal Transmission and Channel Bandwidth: Amplitude Modulation and Channel Bandwidth, Vestigial Sideband, Transmission Efficiency, Frequency modulation and FM Channel Bandwidth, Channel bandwidth for color television, Allocation of frequency bands for TV Signal Transmission, Television	30 hours	1

	Standards		
II	**Picture Tubes, cameras and broadcasting** Picture Tube: Monochrome picture tube, Beam deflection, Screen Phosphor, Face plate, Picture tube characteristics and circuit controls, Television Camera Tubes: Basic Principle, Image Orthicon, Vidicon, Plumbicon, Silicon diode array Vidicon, Solid state image scanners. Television broadcasting: Television studio, Television cameras, Program control room, Video switcher, Synchronizing system, Master control room, Generation of AM, Television transmitter, Positive and negative modulation, Sound signal modulation, Generation of FM, Stabilized reactance modulator, Generation of FM from PM, FM sound signal .	30 Hours	1
III	**Television Receiver and Circuits** Types of television receivers, Receiver sections, Video Detector: Video signal detection, Basic video detector, IF filter, Video detector requirements, Functions of composite video signals, Video section: Picture reproduction, Video amplifier operation, Automatic gain control and noise cancelling circuits: Advantages of AGC, Types of AGC, Delayed AGC, Noise cancellation, AGC adjustments, Sync separation circuits: Sync separator – Basic principle, Transistor sync separator, Noise in sync pulse, Transistor noise gate sync separator, Sync amplifier, Sync processing and AFC circuits: Sync waveform separation, Vertical and horizontal sync separation, Automatic frequency control, Vertical deflection circuit: Vaccum tube vertical deflection stage, Blocking oscillator driven output stage, vertical sweep module, Miller deflection circuit, Horizontal deflection circuit: Horizontal output stage, Sequence of operation, 'S' Correction, Output circuit stabilization, Transistor line output stage, Sound System, Sound signal separation, Sound take off circuits, AM limiting, FM Detection, Sound section integrated circuits, RF Tuner: Tuner operation, Basic coupling circuits, Types of tuners,	30 Hours	1

	Electronic tuning, UHF Tuners, Video IF Amplifiers, Video IF Section, IF Amplifiers, Vestigial sideband correction, IF sound section		
IV	**Color Television: Transmission and Reception** Essentials of color television: Compatibility, Natural Light, Color Perception, Three color theory, Luminance, Hue and Saturation, Polarity of color difference signals, Delta-gun color picture tube, Purity and convergence, Deflection unit, Precision-in-line color picture tube, Trinitron color picture tube, Automatic degaussing circuit, Color signal transmission, Modulation of color difference signal, Weighting factors, Formation of chrominance signal, Color television system: NTSC color receiver, PAL color system, PAL-D color system, SECAM system, Television applications: Cable television, Closed circuit television, Theatre television, Picture phone and facsimile, Video tape recording, Television via satellite, Television games.	30 Hours	1

Text Books:

1. R RGulati, " *Monochrome and Colour Television*", New Age International (P) Ltd Publishers, Revised Second Edition.
2. A.M. Dhake, "*Television and Video Engineering*", McGraw Hill Publications. 2008.

Reference Books:

1. B. Grob and C.E. Herndon, "*Basic Television and Video Systems*", McGraw Hill, 2008.
2. S.P. Bali, "*Colour Television Theory and Practice*", TMH, 2008.
3. G. Kennedy and B. Davis, "*Electronic Communication Systems*", Tata McGraw Hill Publishing Company Ltd., Fourth Edition.

BEC2053 BIO- MEDICAL INSTRUMENTATION

Course Objective:

1. To understand the Origin of Bioelectric potential and their measurements using appropriate electrodes and Transducers.
2. To understand how to measure various biochemical and nonelectrical parameters of human system.
3. To understand the Electro-physiology of various systems and recording of the bioelectric signals.
4. To understand the working principles of various Imaging techniques.
5. To understand the design aspects of various Assist and Therapeutic Devices.

Learning Outcome: Students will be able to

1. Understand the basic physiology of human body.
2. Understand various systems like nervous system, respiratory system etc.
3. Understand various transducers such as resistive, inductive and capacitive.
4. Understand the basics of telemetry and it application.
5. Learn the measurement of blood pressure, blood flow etc.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**1.Basic Physiology** Cells and their structures: Transport of ions through cell membrane, Resting and excited state, Trans-membrane potential, Action potential. Bio Electric potential nervous system: Physiology of muscles-heart, Blood circulations. Respiratory system, Urinary system.	30 Hours	1
II	**2.Basic Transducer Principles and Electrodes** Resistive transducers: Thermistor. Inductive Transducers, Capacitive Transducers, Photoelectric Transducers, Piezoelectric Transducers, Biochemical Transducers- pH, pCo2 and pO2Electrodes.	30 Hours	1
III	**3.Cardiovascular System:**	30 Hours	1

	Heart and cardiovascular system: Blood pressure, Characteristics of blood flow, Heart sounds. Electro cardiography: Measurement of blood pressure, Measurement of blood flow, Cardiac o/p-plethysmography, Measurement of heart sounds.X-ray and Radioisotope Instrumentation**:** X-ray imaging, Radiography, Fluoroscopyimage intensifier, Angiography-medical use of radio isotopes, Beta radiations detectors, Radiation therapy.		
IV	**4. Bio-Telemetry** Intoduction to Bio telemetry: Elements of Bio telemetry system, Design of Bio Telemetry system. Assist and Therapeutic devices: Cardiac Pacemakers, Defibrillators, Artificial Heart, Valves, Artificial Heart Lung machine, Artificial Kidney. Orthopadeic Prosthetics, Respiratory therapy equipment, Patient Monitoring System.	30 Hours	1

Text Books:

1. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeifer, "Biomedical Instrumentation and Measurements", PHI.
2. R.S. Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill.

Reference Books:

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education.
2. John G. Webster, "*Medical Instrumentation Application and Design"*, Wiley India.

BEC2054 INTRODUCTION TO DIGITAL IMAGE PROCESSING

Course Objective:

The objectives of this course are to:

1. Cover the basic theory and algorithms that are widely used in digital image processing
2. Expose students to current technologies and issues that are specific to image processing systems
3. Develop critical thinking about shortcomings of the state of the art in image processing
4. Understand the basic principles and methods of digital image processing,
5. Be able to formulate solutions to general image processing problems,

Learning Outcome:

6. Apply principles and techniques of digital image processing in applications related to digital imaging system design and analysis.
7. Analyze and implement image processing algorithms.
8. Gain hands-on experience in using software tools for processing digital images.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Introduction: Fundamental steps in DIP, elements of DIP, Simple image model, sampling & quantization, basic relationships between pixels, colour image model.	30 Hours	1
II	Image Transforms, One-dimensional & two-dimensional DFT, cosine, sine, Hadamard, Haar and Slant & KL transforms, Image Enhancement : Introduction, point operations, histogram modelling, spatial operations.	30 Hours	1
III	Image Restoration: Introduction, image observation models, Inverse & Wiener filtering, difference between enhancement & restoration Restoration - spatial filtering, Noise reduction in frequency domain.	30 Hours	1
IV	Image Compressionand segmentation: Introduction to compression, Pixel coding, Predictive coding, Predictive	30 Hours	1

	coding, Transform coding, Inter-frame coding, introduction to image segmentation, Spatial feature extraction, Transforms features, Edge detection, Boundary extraction, Segmentation techniques.		

Text/Reference books:

1. Rafael C. Gonzalez Richard E Woods, "Digital Image Processing", Pearson, 3rd Ed. 2009.
2. Anil K Jain, "Fundamentals of Digital Image Processing", PHI