Total Credits= 22

Semester 6th		Contact Hours			Max Marks		Total Marks	Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.		
BECES1-601	Digital Signal Processing	3	1	0	40	60	100	4
BECES1-602	Computer Communication Networks	3	1	0	40	60	100	4
BECES1-603	Digital Signal Processing Lab	0	0	2	60	40	100	1
BECES1-604	Computer Communication Networks Lab	0	0	2	60	40	100	1
BECES1-605	Electronic Measurement	0	0	2	60	40	100	1
BECES1-606	Mini Project/ Electronic Design Workshop	0	0	4	60	40	100	2
BECED1-6XX	Departmental Elective-II	3	0	0	40	60	100	3
XXXXX	Open Elective*	3	0	0	40	60	100	3
BHSMC0-014	Fundamentals of Management for Engineers	3	0	0	40	60	100	3
Departmental Elective - II (Select any one)								
BECED1-611	Microwave Theory & Techniques							
BECED1-612	Power Electronics							
BECED1-613	Embedded Systems							
Total		-	-	-	440	460	900	22

***Open Electives (OE) can also be taken from existing lists of Open Elective-I, Open Elective-II and Open Elective-III subject lists.**

DIGITAL SIGNAL PROCESSING

Subject Code: BECES1-601	L	T	P	C	Duration: 60 Hrs.
	3	1	0	4	

Course Objectives: This course is meant to provide fundamental knowledge to students for understanding of the various concepts and techniques used in digital signal processing:

1. To learn modelling and analysis of discrete time signals and systems.
2. To learn different transforms for the analysis of discrete time signals and systems.
3. To understand implementation of LSI systems.
4. To learn the design of IIR and FIR filters for various applications.

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

1. Represent signals mathematically in continuous and discrete time and frequency domain.
2. Obtain the response of LSI systems to various signals.
3. Apply DFT for the analysis of digital signals & systems.
4. Implementation of LSI systems.
5. Design IIR and FIR filters for various signal processing applications.

UNIT-I (15 Hrs)

Discrete Time Signals and Systems: Review of continuous and discrete type signals, systems and their classification, concept of frequency in continuous time and discrete time signals, analog-to-digital and digital-to-analog conversion, sampling and reconstruction of signals, analysis of LSI systems, discrete time systems described by difference equations, implementation of discrete time systems.

UNIT-II (15 Hrs)

The Z-transform and its Application to the Analysis of LTI Systems: The Z-Transform, properties of Z-Transforms, inverse Z-Transform, one-sided Z-Transform, analysis of LSI systems in the Z-domain.

Frequency Analysis of Signals and Systems: Frequency analysis of continuous-time and discrete time signals, properties of Fourier transform for discrete time signals, frequency domain characteristics of linear time-invariant systems, linear time-invariant systems as frequency-selective filters, inverse systems and de-convolution.

UNIT-III (15 Hrs)

The Discrete Fourier Transform its Properties and Applications: Frequency domain sampling, the discrete Fourier transform, properties of the DFT, linear filtering methods based on the DFT, frequency analysis of signals using the DFT.

Fast Fourier Transform: Efficient computation of DFT, FFT algorithms and their application, linear filtering approach for computation of DFT, quantization effect in the computation of DFT.

UNIT-IV (15 Hrs)

Implementation of Discrete Time Systems: Structures for the realization of discrete time systems, structures for FIR Systems, structures for IIR systems, representation of numbers, quantization of filter coefficients, round off effect in digital filters.

Design of Digital Filters: Design of FIR filters: window method, Parks-McClellan method, design of IIR filters Butterworth, Chebyshev and Elliptic approximations, low pass, high pass, band pass and band stop filters.

Recommended Text Books / Reference Books:

1. J.G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Pearson Prentice Hall.
2. V. K. Ingle, J.G. Proakis,"Digital Signal Processing Using MATLAB",Cengage Learning.
3. S.K. Mitra, "Digital Signal Processing: A Computer Based Approach", TMH.
4. A.V. Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", Prentice Hall.
5. B. Widrow and S.D. Stearns, "Adaptive Signal Processing", Prentice Hall.

COMPUTER COMMUNICATION NETWORKS					
Subject Code: BECES1-602	**L**	**T**	**P**	**C**	**Duration: 60 Hrs.**
	3	1	0	4	

Course Objectives:

This course is meant to provide fundamental knowledge to-

1. Understand layering architecture of OSI / TCP/IP protocol suite for computer networks
2. Understand the protocols associated with each layer.
3. Understand concepts of wireless, adhoc and various emerging network technologies.
4. Familiarize students with basic design concepts and issues of cellular wireless networks

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

1. Describe the architecture of computer and wireless communication networks
2. Compare OSI reference model and TCP/IP protocol suite.
3. Classify computer and communication networks and associated standards
4. Acquire knowledge about wireless cellular communication with different technologies.
5. Compare wireless networks on the basis of technologies, architecture and applications
6. Assess the performance of a cellular network in terms of its coverage and capacity
7. Apply knowledge in understanding working of various emerging network technologies

UNIT-I (15 Hrs)

Introduction to computer networks: Data Communication System and its components, Computer network and its goals, Types of computer networks: LAN, MAN, WAN, Wireless and wired networks, circuit switching and packet switching, Network topologies, Network software: concept of layers, protocols, interfaces and services, ISO-OSI reference model, TCP/IP reference model.

Basics of Wireless networks: Wireless network: Architecture, Classification, Reference model, Wireless networking issues and standards

UNIT-II (15 Hrs)

Wireless LAN: Design requirements of WLAN, Network Architecture- Infrastructure Based WLAN, Infrastructure-less WLAN, IEEE 802.11

WLAN Protocols: for Physical layer, MAC layer and Routing in WLAN, IPv4 versus IPv6: Header formats and Addressing Structure

UNIT-III (15 Hrs)

Wireless Wide Area Networks: Cellular Networks: Principals of Cellular n/w, WLAN versus WWAN- coverage, speed, data security, costs, Applications, Internetworking of WLAN and WWAN

Wireless System Design: Introduction, Frequency reuse, Co- Channel Interference, Channel assignment strategies, handoff strategies, interference and system capacity, improving coverage

and capacity in cellular systems. Comparison of 2G, 3G, 4G and 5G cellular network features.

UNIT-IV (15 Hrs)

Introduction & Applications of Wireless Adhoc Network, Wireless sensor networks, Wireless Mesh networks, VANETs.

Recommended Text Books / Reference Books:

1. Computer Networks, 4th Edition, Pearson Education by Andrew S. Tanenbaum.
2. Data Communication & Networking, 4th Edition, Tata McGraw Hill. By Behrouz A. Forouzan.
3. Sunil kumar S. Manvi, Mahabaleshwar S. Kakkasageri, Wireless and mobile networks: concepts and protocols, Wiley India.
4. Networking, 3rd Edition, Pearson Education by James F. Kurose and Keith W. Ross
5. Theodore S. Rappaport, Wireless Communication: Principles and Practices (2ndEdition), Pearson Education.

DIGITAL SIGNAL PROCESSING LAB					
Subject Code: BECES1-603	**L**	**T**	**P**	**C**	**Duration: 30 Hrs.**
	0	0	2	1	

Course Objectives: This course is meant to provide fundamental knowledge to students for understanding of the various signals mathematically in continuous and discrete time and frequency domain.

1. To implement linear and circular convolution.
2. To develop and implement programs for computing Z-transform, DFT and IDFT
3. To design of different types of digital- FIR and IIR filters for various applications

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

1. Understand the handling of discrete signals using MATLAB platform.
2. Understand the basic operations of digital signal processing.
3. Design IIR and FIR filters for low pass and high pass applications.

LIST OF EXPERIMENTS

1. To develop program modules based on operation on sequences like signal shifting, signal folding, signal addition, signal multiplication and linear convolution.
2. Write a program in MATLAB to draw pole-zero plot, amplitude, phase and impulse response (s) from the given transfer function of a discrete-time causal system.
3. To develop program for finding response of the LTI system described by the difference equation/system function H(z).
4. To develop program for computing Z-transform and inverse Z-transform.
5. Write a program in MATLAB to verify the circular convolution.
6. To develop program for computing DFT and IDFT of a given sequence.
7. Write a program in MATLAB to design FIR filters (LP/HP) using rectangular and triangular window techniques for given specifications.
8. Write a program in MATLAB to design Low Pass Butterworth IIR filter.
9. Write a program in MATLAB to design Chebyshev – I & II Low Pass IIR filters.
10. To develop program for conversion of direct form realization to cascade form realization.

COMPUTER COMMUNICATION NETWORKS LAB

Subject Code: BECES1-604	L	T	P	C	Duration: 30 Hrs.
	0	0	2	1	

Course Objectives:

1. To develop an understanding of networking hardware components
2. Familiarization with a networking simulator and its working.
3. Simulation based performance analysis of LAN and its different topologies
4. Simulating network and transport layer protocols
5. Learning to configure LAN &WLAN and security firewall

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

1. Identify the different types of network devices and their functions within a network
2. Compare different network topologies
3. Familiarity with the basic protocols of computer networks
4. Acquire the ability to setup and configure LAN/WLAN.
5. Analyze the simulated performance of different protocols.

LIST OF EXPERIMENTS

1. Familiarization with Networking Components and devices: LAN Adapters, Hubs, Switches, Routers etc.
2. Familiarization with Transmission media and Tools: Co-axial cable, UTP Cable, Crimping Tool, Connectors etc.
3. Study of various network simulators and Installation of a network simulator
4. Implementation and plotting performance characteristics of Bus/STAR/Ring based LAN using any network simulator
5. Configure Host IP, Subnet Mask and Default Gateway in a a LAN System (TCP/IP based).
6. Establish Peer to Peer network connection using two systems using Switch and Router in a LAN
7. Performance Analysis of any one(Open Shortest Path First (OSPF)/ RIP/DVR) routing protocol through simulation.
8. Simulation of any one Congestion control Algorithm (in TCP) and finding Packets Drop Rate
9. Firewall implementation in providing security to shared public networks such as internet.
10. Learning to install and configure WLAN and wireless access points.

ELECTRONIC MEASUREMENT

Subject Code: BECES1-605	L	T	P	C	Duration: 30 Hrs.
	0	0	2	1	

Course Objectives: This course is meant to provide fundamental knowledge of measurements and measuring instruments related to electronics engineering.

1. To make aware the students about basic concepts and definitions in measurement.
2. To provide knowledge about different types of measuring, waveform generation and analysis of electronic instruments.
3. To provide detailed knowledge about different bridges.
4. To understand CRO and its operation.

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

1. Design and validate DC and AC bridges
2. Analyze the dynamic response and the calibration of few instruments.
3. Learn about various measurement devices, their characteristics, their operation and their limitations.
4. Understand data acquisition.

CONTENTS

Generalized instrumentation system, classification of errors in measuring instruments, static and dynamic characteristics of instruments.

Resistance measurement using Wheatstone bridge, Kelvin double bridge, ohm meter, ac bridges- Maxwell bridge, Wein bridge, Hey's bridge, Schering bridge, Anderson bridge, Campbell bridge, LVDT.

Principles and working of CRO, CRO probes, Measurement of voltage, frequency and phase angle with CRO.

LIST OF EXPERIMENTS

1. Designing DC bridge for resistance measurement (Quarter, half and full bridge).
2. Designing AC bridge circuit for capacitance measurement.
3. Measurement of frequency using Wein's bridge.
4. Designing signal conditioning circuit for pressure and temperature measurement.
5. Designing signal conditioning circuit for torque and strain measurement.
6. Experimental study for the characteristics of ADC and DAC.
7. Error compensation study using numerical analysis using MATLAB (regression)
8. To determine output characteristics of LVDT and measure displacement using LVDT.
9. Determine frequency and phase angle using CRO.
10. Measurement of unknown voltage using potentiometer.

Text/Reference Books:

1. Prithwiraj P., Budhaditya B., Santanu D., Chiranjib K., "Electrical and Electronics Measurements and Instrumentation", McGraw Hill.
2. W.D. Cooper, "Electronic Instrumentation and Measurement Techniques", Prentice Hall.
3. K. Lal Kishore, "Electronic Measurements and Instrumentation", Pearson Education.
4. A.K. Sawhney, "Electrical & Electronic Measurement and Instrumentation", Dhanpat Rai & Publishers.
5. J.B. Gupta, "A Course in Electrical and Electronics Measurement & Instrumentation", S.K. Kataria & Sons.

PROGRAM ELECTIVE-II

MICROWAVE THEORY AND TECHNIQUES					
Subject Code: BECED1-611	**L**	**T**	**P**	**C**	**Duration: 45 Hrs.**
	3	0	0	3	

Course Objectives:

1. To understand Waveguides and different modes.
2. To Understand various microwave components and their properties.
3. To provide knowledge on the different antenna parameters and antenna types.
4. To gain knowledge about various Microwave Systems

Course Outcomes:

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

1. Understand various microwave system components and their properties.
2. Analyze microwave circuits using scattering parameters.
3. Analyze various antenna parameters and different kinds of antennas.
4. Understand different microwave systems.

UNIT-I (12 Hrs)

Introduction to Microwaves- History of Microwaves, Microwave frequency bands, Applications of microwaves.

Waveguides: Introduction to rectangular waveguide, circular waveguide and Planar Transmission line, Comparison of Waveguide with transmission line, Propagation in TE, TM and TEM modes, characteristic impedance.

UNIT-II (12 Hrs)

Microwave Components:S-parameters, Directional coupler, E-plane Tee, H-plane Tee, magic tee and their S-parameters, attenuator, cavity resonator, Ferrite devices: Circulator, Isolator, Gyrator.

Microwave Devices: Limitations of Conventional Tubes, Construction, Operation and Properties of Two Cavity Klystron amplifier, Reflex Klystron Oscillator, Travelling Wave Tube, Magnetron. Gunn diode and PIN diode

UNIT-III (10 Hrs)

Antenna Parameters: Radiation pattern, Gain, Directive gain, Directivity, Effective Aperture, Front to Back ratio, Antenna Beam Width, Antenna Bandwidth, Antenna Beam Efficiency, Antenna Beam Area or Beam Solid Angle.

Broadband Antennas: Introduction to Aperture Antenna, Slot Antenna, Microstrip or Patch Antenna, Smart Antenna.

UNIT-IV (11 Hrs)

Microwave Measurements: Measurement of standing wave ratio, measurement of wavelength and frequency, measurement of power, radiation pattern measurement of antenna

Microwave Systems: Radar, Terrestrial and Satellite Communication, Radio aids to navigation, RFID, GPS

Recommended Text Books / Reference Books:

1. Collin, R.E., "Foundations for Microwave Engineering", 2nd Ed., John Wiley & Sons. 2000.
2. Pozar, D.M., "Microwave Engineering", 3rd Ed., John Wiley & Sons. 2004
3. Edwards, T.C. and Steer M.B., "Foundations for Interconnects and Microstrip Design", 3rd Ed., John Wiley & Sons. 2001
4. Ludwig, R. and Bretchko, P., "RF Circuit Design", Pearson Education. 2000
5. Hunter, I., "Theory and Design of Microwave Filters", IEE Press. 2001
6. Misra, D.K., "Radio-frequency and Microwave Communication Circuits", John Wiley & Sons.
7. Samuel Y Liao, "Microwave Devices and Circuits", Pearson Publication
8. M. Kulkarni, "Microwave and Radar Engineering", Umesh Publication

POWER ELECTRONICS					
Subject Code: BECED1-612	**L**	**T**	**P**	**C**	**Duration: 45 Hrs.**
	3	0	0	3	

Course Objectives: This course is meant to provide fundamental knowledge to students for understanding of the various concepts and techniques used in power electronics:

1. Ability to analyze various power converter circuits.
2. To develop skills to build, and troubleshoot power electronics circuits.
3. Acquire knowledge about current applications of power electronics in industry.
4. To analyze and design of different types of chopper circuits

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

1. Build and test circuits using power devices such as SCR.
2. Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters.
3. Learn how to analyze these inverters and some basic applications.
4. Apply power electronics technology to design SMPS.

UNIT-I (12 Hrs)

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT, concept of fast recovery and schottky diodes as freewheeling feedback diode.

Power Devices: TRIAC, MOS Controlled Thyristor (MCT), Power Integrated Circuits (PIC) (Smart Power),Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFET and IGBT

UNIT-II (10 Hrs)

Phase Controlled Rectifier: Single phase: study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current – derivations of load form factor and ripple factor, effect of source impedance, input current, Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

UNIT-III (12 Hrs)

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and Type E choppers, control techniques for choppers - TRC and CLC, detailed analysis of Type A chopper, multiphase chopper.

Single-Phase Inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters along with driver circuits and comparison of their performance, single phase current source inverter.

UNIT-IV (11 Hrs)

Switching Power Supplies: Analysis of fly back, forward converters for SMPS, resonant converters-need, concept of soft switching, switching trajectory and SOAR, load resonant converter-series loaded half bridge DC-DC converter, block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings and sizing of UPS.

Recommended Text Books / Reference Books:

1. Muhammad H. Rashid, “Power Electronics” Prentice Hall of India.
2. Ned Mohan Robbins, “Power Electronics” Edition-III, John Wiley sons

3. P.C. Sen., "Modern Power Electronics" Edition-II, Chand & Co.
4. V. R. Moorthi, "Power Electronics", Oxford University Press.
5. Cyril W., Lander, "Power Electronics" Edition-III, McGraw Hill.
6. G.K. Dubey, S.R. Doradla, " Tyristorised Power Controllers", New Age International Publishers. SCR manual from GE, USA.
7. P.S. Bimbhra, "Power Electronics", Khanna Publishers, New Delhi, 2012.

EMBEDDED SYSTEMS					
Subject Code: BECED1-613	**L**	**T**	**P**	**C**	**Duration: 45 Hrs.**
	3	0	0	3	

Course Objectives: This course is meant to provide fundamental knowledge to students for understanding embedded systems.

1. To make aware the students about the concept of embedded systems.
2. To impart knowledge of different types of embedded processors.
3. To provide the students concepts of interfacing of embedded processors.
4. To implement basic programming using embedded processors.

Course Outcomes: At the end of the course, students will demonstrate the ability to:

1. Build design approach using advanced controllers to real-lifesituations.
2. Designinterfacingofthesystemswithotherdatahandling/processingsystems.
3. Appreciateengineeringconstraintslikeenergydissipation,dataexchangespeedsetc.

UNIT-I (10 Hrs)

Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging

UNIT-II (12 Hrs)

Complex Systems and Microprocessors– Embedded system design process –Design example: Model train controller- Instruction sets preliminaries – ARM Processor – CPU: programming input and output- supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance- CPU power consumption

UNIT-III (11 Hrs)

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols – RS232 standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers.

UNIT-IV (12 Hrs)

The CPU Bus-Memory devices and systems: Designing with computing platforms – consumer electronics architecture – platform-level performance analysis – Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing

Recommended Text Books / Reference Books:

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000
2. David Simon, "An Embedded Software Primer", Addison Wesley,2000.
3. Jack Ganssle, "The Art of Designing Embedded Systems",Newness, 1999.
4. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications",

Penram Intl,1996.
5. Marilyn Wolf, "Computers as Components – Principles of Embedded Computing System Design", Third Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
6. Rajkamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013.
7. Peckol, "Embedded system Design", John Wiley & Sons,2010.