Subject Code	Subject Name	Contact Hours			Max Marks		Total Marks	Credits
		L	T	P	Int.	Ext.		
BECEM1-001	Analog Electronic Devices, Circuits & Applications	3	0	0	40	60	100	3
BECEM1-002	Digital Logic System Design	3	1	0	40	60	100	4
BECEM1-003	Electronic Communication Systems	3	0	0	40	60	100	3
BECEM1-004	Microprocessors & Microcontrollers	3	1	0	40	60	100	4
BECEM1-051	Analog Electronic Circuits Lab	0	0	2	60	40	100	1
BECEM1-052	Microprocessors & Microcontrollers Lab	0	0	2	60	40	100	1
Departmental Elective (Select any one)								
BECEM1-005	Sensors, Measurements & Industrial Instrumentation	3	1	0	40	60	100	4
BECEM1-006	Computer Communication Networks	3	1	0	40	60	100	4
BECEM1-007	Artificial Intelligence	3	1	0	40	60	100	4
BECEM1-008	Wireless AdHoc & Sensor Networks	3	1	0	40	60	100	4
BECEM1-009	VHDL Design	3	0	0	40	60	100	3
BECEM1-053	VHDL Design Lab	0	0	2	60	40	100	1

Note: Minimum 20 credits to be earned by choosing only one subject from Department Elective list.

ANALOG ELECTRONIC DEVICES, CIRCUITS & APPLICATIONS					
Subject Code: BECEM1-001	**L**	**T**	**P**	**C**	**Duration: 45 Hrs.**
	3	0	0	3	

Course Objectives:

1. To impart knowledge of BJTs and FETs.
2. To provide the students detailed concepts of MOSFETs and CMOSFETs.
3. To analyze low and high frequency transistor models.
4. To understand the characteristics of various power amplifiers.
5. To understand various types of feedback amplifiers topologies and oscillatiors.
6. To make the students aware about the various multi vibrator circuits.
7. To understand various Applications of Op amp.

Course Outcomes:

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

1. Understand the characteristics of BJTs, FETs, MOSFETS and CMOS devices.
2. Design and analyze various amplifier circuits using BJTs, FETs, MOSFETS and CMOS devices.
3. Design sinusoidal and non-sinusoidal oscillators
4. Understand the functioning of OP-AMP and design OP-AMP based circuits
5. Design and analyze different power amplifiers and multivibrator circuits.

UNIT-I (15 Hrs.)

Diodes and Applications: PN junction diode: its operation and applications as a switch and as rectifier, Special Purpose diodes: Zener diode, Photo Diode, LEDs, LCDs, Solar Cell, Schottky diode, Varactor Diode, Tunnel Diode their characteristics and applications.

Bipolar Junction Transistor: BJT and its operation, Various BJT configurations and their I-V characteristics, Biasing techniques, and bias stability, BJT applications as a switch and as an amplifier.

Field Effect Transistor: JFET and its operation, various configurations and I-V characteristics, Biasing techniques, FET as a switch and as an amplifier, MOSFETs; their operation and characteristics, MOS applications as a switch and as an Inverter, CMOS devices and application of CMOS as inverter.

UNIT-II (10 Hrs.)

Feedback Amplifiers and Oscillators: Concept of negative feedback, Feedback topologies, effect of feedback on gain, bandwidth, input/output impedances etc., practical circuits, concept of stability, Concept of positive feedback, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), Crystal oscillator.

UNIT-III (8 Hrs.)

Operational Amplifiers and Applications: Basic structure and principle of operation, differential gain, common mode gain, CMRR and ICMR, OP-AMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation. Op-Amp as integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger.

UNIT-IV (12 Hrs.)

Power Amplifiers: Frequency response of single stage amplifiers, Multistage amplifiers, Different coupling schemes for multistage amplifiers, different classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Push-pull amplifier, cross over distortion, complementary symmetry push-pull amplifier.

Multivibrators: Collector/Emitter Coupled- Astable, Mono-stable multivibrators and Fixed/Self biased Bistable mutlivibrators, Triggering methods of Monostable and Bistable multivibrators.

Recommended Text Books / Reference Books:

1. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
2. J. MillmanandA. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
3. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
4. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, Edition-IV
5. Paul R. Gray and Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, JohnWiley, 3rd Edition

ANALOG ELECTRONIC CIRCUITS LAB

Subject Code: BECEM1-051 | **L T P C** 0 0 2 1 | **Duration: 30 Hrs.**

Course Objectives:

1. To impart knowledge of BJTs and FETs.
2. To provide the students detailed concepts of MOSFETs and CMOSFETs.
3. To analyze low and high frequency transistor models.
4. To understand the characteristics of various power amplifiers.
5. To understand various types of feedback amplifiers topologies andoscillatiors.
6. To make the students aware about the various multivibrator circuits.
7. To understand various Applications of Op amp.

Course Outcomes:

1. An ability to understand different types of electronics devices and circuits.
2. An ability to design and conduct experiments, as well as to analyze and interpret output.

LIST OF EXPERIMENTS

1. To plot the input and output characteristics of BJT in CB, CE and CC configurations.
2. To demonstrate use of BJT as amplifier in a CE configuration.
3. To plot the input and output characteristics of JFET in CG, CS and CD configurations.
4. To perform an experiment to observe the working of JFET as an amplifier.
5. To plot the input and output characteristics of MOSFET.

To observe the response of RC phase shift oscillator/ Wien Bridge oscillator/ Hartley oscillator and Colpitt's oscillator and determine frequency of oscillation.

To demonstrate Application of Op amp as Inverting amplifier, Non-Inverting amplifier, summing, scaling & averaging amplifier.

To observe and analyze the frequency response of Class- A & Class- B amplifier.

To observe and analyze the frequency response of Class- B push-pull amplifier and complementary symmetry push-pull amplifier.

To demonstrate and study a single stage RC coupled amplifier/ Transformer coupled amplifier.

DIGITAL LOGIC SYSTEM DESIGN

Subject Code: BECEM1-002 **L T P C** **Duration: 60 Hrs.**

3 1 0 4

Course Objectives:

1. To provide knowledge of basics of digital electronics & its application
2. To impart knowledge about designing of digital logic circuits
3. To create solutions for real life design problems

Course Outcomes:

After the completion of the course, student/s shall demonstrate the ability/skills to:

1. Having understood working of Logic families; Logic gates & Digital arithmetic
2. Design and implement Digital arithmetic based Combinational & Sequential logic circuits
3. Design and analyze modular combinational circuits with Mux/Demux; Decoders & PLDs
4. Design and analyze Synchronous & asynchronous sequential logic circuits
5. Having understood Data processing, A/D interfacing and FSM based real life design problems

UNIT-I (15 Hrs.)

Fundamentals of Digital Systems and Boolean Algebra: Digital vs Analog Signals; Digital logic & Digital system; Digital logic states; Number Systems (Binary/ Octal/ Hex/ BCD); Fixed & Floating point representations; Signed & Unsigned number representations; r's & r-1's Complements & complement realizations; Logic gates- Basic, Composite, Universal gates and their Applications; Positive & Negative Logic; Boolean Algebra, Huntington postulates & Theorems; Duality; SOP/POS canonical/non-canonical models; Binary/Octal/Hex Arithmetic

Logic Circuit Minimization: Boolean functions; Minimization & its effect on Performance parameters; Boolean algebra/ theorems based simplifications; K-Map: with Min/Max terms; Prime/Essential implicants in Single & Multi outputs; Logical, Kitty-corner adjacency and Offset based map simplification; True & Complement form; with/without don't care conditions; SOP/POS simplifications; Multi-output matching; Two level and Multiple level logic; VEMs; Hazards/Glitches- (Static/dynamic); their Identification, effect & Hazard-free simplification; Simplified Ckt& AND/OR Array realizations; Cost Analysis; Q-M Technique based Minimization

UNIT-II (15 Hrs.)

Logic families: TTL; ECL; CMOS/ BiCMOS based gate realizations; ICs and their characteristics; various TTL gate ICs (74xx/54xx)

Combinational Circuits Logic Design: Combinational Circuit design procedure; Seral & Parallel Multi-bit (Nibble/Byte) IC based Adder/BCD-Adder/LCA-Adder; Subtractor; Magnitude Comparator; Squaring Ckt; Decoder/ Decoder Drivers; Encoder/ Priority Encoders; Mux/Demux; their scalability and SOP/POS logic Ckt design using AND-OR; NAND; NOR gates/Decoders/Mux; Codes/ Error Detection & Correction: BCD/Gray/XS-3/ASCII/EBCDIC/Hamming codes; Code Converters- BCD/Gray, BCD/7-segment; BCD/XS-3; Odd/Even Parity and Hamming Code based Generation & Correction Ckt mechanisms

UNIT-III (15 Hrs.)

Synchronous Sequential Circuits Logic Design: Latches & Flip-Flops; SR/D/JK/T Clocked & Level/Edge triggered FFs, Truth tables & Excitation tables; Racing in FFs; Master/Slave FFs; Conversion of FFs; Latches & FF Applications; Shift Registers & their types, Universal Shift Register design; Counters (Asynchronous/Ripple & Synchronous); Design of Up/Down; Modulo-N; Ring/Johnson; Special Counters; Sequence generators;

Memories Organization & Fundamentals of Programmable logic Devices: Memory Cell; Operations; RAM; ROM/PROM/EPROM/EEROM; CAM; CCD; PLDs: SPLDs; PROMs/28C010, PLA/82S100, PAL/Atmel PAL-16R4/22V10, GAL/16V8C based simple SOP circuit designs & logic implementation; Cascading & different PAL I/O mechanisms, CPLDs, FPGAs, ASICs & HDL

UNIT-IV (15 Hrs.)

Data Processing and Conversion: DAC: Performance parameters; Errors- Gain & Offset error; Non-Linearity error; Monotonicity error; Settling Time & Overshoot; Types- Weighted resister; Resistive Ladder; Working & Comparative performance; ADC: S/H Ckt (Sampling mechanisms of single/multiple frequency signals, Aliasing); Performance parameters- Resolution; Dynamic Range; Conversion-time; Bandwidth; Errors- Nonlinearity (integral/ Differential); ADC Transfer characteristics; Types -Flash; Counter; Tracking; Successive Approximation and Dual Slope; Working and Comparative performance

Finite State Machines: FSMs- Capabilities & limitations; Moore & Mealy m/cs; State diagram; State table; State assignment & Minimization; Excitation table; Transition & output table; State Reductions & assignment; Design of Sequential ckts; Synchronous sequential m/cs; ASMs & its features; ASM charts; ASMs for Binary Multiplier/Vending machine/Weighing machine; Hazards in Sequential Circuits

Recommended Text Books / Reference Books:

1. Digital Electronic Circuits by Prof Goutam Saha, IIT Kharagpur (NPTEL Online Certification Course)
2. Digital Circuits by Prof Santanu Chattopadhyay, IIT Kharagpur (NPTEL Online Certification Course)
3. Switching Circuits and Logic Design by Prof Indranil Sen Gupta, IIT Kharagpur (NPTEL Online Certification Course)
4. Digital Circuits and Systems by Prof S Srinivasan, IIT Madras (NPTEL Online Certification Course)
5. Digital Design by M Morris Mano, Pearson's

6. Digital Principles & Applications by Malvino& Leach, McGraw Hill

ELECTRONIC COMMUNICATION SYSTEMS					
Subject Code: BECEM1-003	**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 electronic communication system.

1. To make aware the students about the concept of communication system.
2. To impart knowledge of different types of analog modulation/demodulation schemes.
3. To provide the students detailed concepts of digital communication scheme.
4. To impart knowledge about information theory.

Course Outcomes:

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

1. Understand the modulation scheme in analog and digital communication.
2. Analyze the modulators and demodulators
3. Understand the mathematical analysis of digital coding schemes.

UNIT-I (12 Hrs.)

Introduction to communication system, Need for modulation, Amplitude Modulation, Definition, Time domain and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves, square law Modulator, Switching modulator, Detection of AM Waves; Square law detector, Envelope detector, Double side band suppressed carrier modulators, time domain and frequency domain description, Generation of DSBSC Waves, Balanced Modulators, Ring Modulator.

UNIT-II (12Hrs.)

Basic concepts of angle modulation, Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave, Narrow band FM, Wide band FM, Constant Average Power, Transmission bandwidth of FM Wave - Generation of FM Waves, Direct FM, Detection of FM Waves: Balanced Frequency discriminator, Zero crossing detector, Phase locked loop, Comparison of FM and AM.

UNIT-III (10 Hrs.)

Introduction, Information Capacity, Bits, Bit Rate, Baud rate & M-ary Encoding, ASK, FSK, PSK, QAM, Introduction to PCM & DPCM, DM & ADM, Introduction to PAM, PPM and PWM, Concept of M-arysignalling scheme.

Introduction to Linear block codes and Convolutional block codes. Error correction and detection using block codes.

UNIT-IV (11 Hrs.)

Introduction to information theory, Entropy and its properties, Source coding theorem, Huffman coding, Shannon-Fano coding. Run Length Encoding, Discrete memory less channel, Mutual information. Channel capacity, Channel coding theorem, Differential entropy and mutual Information for continuous ensembles, Information Capacity theorem.

Recommended Text Books / Reference Books:

1. Communication Systems by Simon Haykins John Wiley &Sons , 4th Edition.
2. Electronic Communications – Dennis Roddy and John Coolean , 4th Edition , PEA, 2004
3. Communication Systems – B.P. Lathi, BS Publication , 2004.
4. Electronics & Communication System – George Kennedy and Bernard Davis , TMH 2004.

5. N. Abramson, Information and Coding, McGraw Hill,1963.
6. M. Mansurpur, Introduction to Information Theory, McGraw Hill,1987.
7. Advanced Electronic Communications Systems, by Wayne Tomasi, 6 Edition Pearson Education.
8. Simon Haykin, Digital communications, John Wiley and sons.
9. Sanjay Sharma, Digital Communication Systems, S. K. Kataria and Sons

MICROPROCESSORS & MICROCONTROLLERS

Subject Code: BECEM1-004 | **L T P C** 3 1 0 4 | **Duration: 60 Hrs.**

Course Objectives:

This course is meant to provide fundamental knowledge to students for understanding of the architecture, programming of microprocessor and microcontroller along with interfacing with peripherals:

1. To understand the architecture of various microprocessor and microcontroller.
2. To understand interfacing of microprocessor with memory and peripheral devices.
3. To learn assembly language programming for 8 bit microprocessors and microcontrollers.
4. To apply the interfacing and programming techniques of microprocessors and microcontrollers in practical problems/projects.

Course Outcomes:

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

1. To learn architecture of microprocessors 8085 & 8086 and microcontroller 8051.
2. To understand interfacing of microprocessor 8085 with memory and peripheral devices.
3. To write assembly language programs for 8 bit microprocessors and microcontrollers.
4. To apply and implement the interfacing and programming techniques of microprocessors and microcontrollers in various practical problems/projects.

UNIT-I (15 Hrs.)

Introduction: Intel 8085 microprocessor architecture, Pin functions, Bus configuration, Timing diagram, Addressing modes, Instruction Format, Instruction set, I/O & memory interfacing, Counters, Time Delays, Stack and Subroutines, interrupts and assembly language programming.

UNIT-II (15 Hrs.)

Interfacing I/O devices: Interfacing I/O ports, PPI chips 8155 & 8255, Interrupt controller 8259, Serial and parallel data transfer chips, case studies: Traffic Light control, LED display.

UNIT-III (15 Hrs.)

Overview of 8086: Block diagram, architecture, pipelining, flag register, register bank operation, memory segmentation, addressing modes, concept of virtual memory, cache memory, Max and Min modes.

UNIT-IV (15 Hrs.)

Introduction to Microcontroller: Comparison of microcontroller and microprocessors, 8051 microcontroller - architecture and pin functions, flag bits and PSW register, SFRs, register banks, addressing modes, Memory Organization, I/O Ports and Circuits, Timers, Stack, Interrupts,

Serial Communication, Interfacing of External Memory and LCD, 8051 instruction set and Programming.

Recommended Text Books / Reference Books:

1. R.S. Gaonkar, 'Microprocessor Architecture Programming and Applications with the 8085', Penram International Pub.
2. D.V. Hall, 'Microprocessor and Interfacing Programming and Hardware', McGraw Hill Co.
3. Barry B. Brey, 'The Intel Microprocessors, Architecture Programming and Interfacing', PHI Publications.
4. Mazidi Muhammad Ali, 'The 8051 Microcontroller and Embedded Systems', Pearson Publications.
5. John Uffenbeck, "The 80x86 Family: Design, Programming, and Interfacing, Pearson Publications.
6. Kenneth J. Ayala, 'The 8051 Microcontroller', Thomson Publishers.

MICROPROCESSORS & MICROCONTROLLERS LAB

Subject Code: BECEM1-052 | **L T P C** 0 0 2 1 | **Duration: 30 Hrs.**

Course Objectives:

This course is meant to provide fundamental knowledge to students for understanding of the assembling language programming using 8085/8086/8051:

1. To introduce assembling language programming concepts.
2. To differentiate serial and parallel interface.
3. To interface different I/Os with microprocessor(s) and microcontroller.
4. Introduce the practical concepts to control spee of DC and stepper motor.

Course Outcomes:

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

1. Interface different I/Os with processor.
2. Execute various assembling language programs in 8085/8051.
3. Write programs for 8051 micro controller kit.
4. Understand programs for speed control of stepper motor and DC motor.

LIST OF EXPERIMENTS

1. Study of 8085/8086 microprocessor(s) and 8051 microcontroller kits.
2. Write a program to add two 8-bit/16-bit numbers using 8085.
3. Write a program to subtract two 8-bit/16-bit numbers using 8085.
4. Write a program to multiply two 8 bit numbers by repetitive addition method using 8085.
5. Write a program to sort series using bubble sort algorithm using 8085.
6. Write a program to control the operation of stepper motor using 8085 microprocessor and 8255 PPI.
7. Write a program to add two numbers lying at two memory locations and display the result using 8051.
8. Write a Program to arrange 10 numbers stored in memory location in ascending and descending order using 8051.
9. Write a program of Flashing LED connected to port 1 of the microcontroller using 8051.
10. Write a program to generate a Ramp waveform using DAC with microcontroller using 8051.

SENSORS, MEASUREMENTS & INDUSTRIAL INSTRUMENTATION					
Subject Code: BECEM1-005	**L**	**T**	**P**	**C**	**Duration: 60 Hrs.**
	3	1	0	4	

Course Objectives:

1. To provide knowledge of various sensors, transducers and application areas of measurement
2. To familiarize with basics of sensor-based measurements, Instrumentation & its application
3. To impart knowledge about designing of sensor based industrial instrumentation systems

Course Outcomes:

After the completion of the course, student/s shall demonstrate the ability/skills to:

1. Having understood working of various types of sensors, transducers and their performance parameters
2. Having understood problems and solutions of sensors installation, working for enhanced performance
3. Having understood design of industrial automation measurement systems

UNIT-I (15 Hrs.)

Introduction: Role of industrial instrumentation in quality output; Classification of Industrial Instruments; Typical Process Instrumentation System; Process parameters: Control actions & Signal conditioning; Applications of Measurements and Control; Sensors/Transducers and its nomenclature

Sensor/system Static and Dynamic Measurement Characteristics

Strain Gauges: Principle & working; Composition/backings; Temp compensation; Gauge factor; Types; Strain Gauge Instrumentation; Qualitative & Quantitative analysis; Gauge Characteristics & Applications

Load Cells: Principle & working; Types& Ranges; Installation & orientation; Sensitivity; Creep/fatigue; Load Cell instrumentation; Quantitative analysis; Characteristics & Applications

Thermistors: Composition; Sizes/shapes; Semiconductor sensors; Analytical treatment; Thermistor based Instrumentation Lead wire resistances; Self heating error; Thermistor Characteristics & Applications

Thermocouples: Principle of working; Theory &types; Performance parameters; lead wires; Junction Compensations; Semiconductor temp sensors; Signal conditioning/Grounded ckts; Characteristics and Application; Thermopiles; Dynamic Temp measurements

RTDs: Theory, Construction and materials; Signal Conditioning; Self heating, Contact and Lead wire resistances; 1-wire, 3-wire and 4-wire/Mueller Lead wire circuits; Characteristics and Applications

LVDTs: Theory, Construction; LVDT Signal conditioning circuits; Lead/lag Networks; Phase sensitive demodulator circuits; Null voltage reduction circuits; Characteristics and applications

Capacitive Transducers: Principle, Theory/Geometric variations; linearization; Capacitive sensors as Displacement sensors, Level gauge and as DP Transmitters; Differential capacitor pick- ups; Characteristics & Applications

UNIT-II (15 Hrs.)

Flowmeters: Volumetric, Mass, Quantity FMs; Principle of operation, Construction and Theory of DP-FMs; Variable area FMs; PD-FMs; Turbine FM; Electromagnetic FM; Vortex Shedding FM; Ultrasonic FMs; Laser Doppler FMs; Anemometers & Signal conditioning; Comparison; Characteristics & Applications in Invasive-Non-invasive; Closed, Open channel; Flow Transmitters (4/20mA)

Pressure Sensors

UNIT-III (15 Hrs.)

Ph & Viscosity Measurements, Piezoelectric and Ultrasonic Sensors, Magnetic Field and optoelectronic Sensors, Synchros

UNIT-IV (15 Hrs.)

Dissolved oxygen Sensors, Flapper Nozzle sensors & Smart Sensors, Chromatography and Pollution Measurements, Control Valve

Recommended Text Books / Reference Books:

1. Industrial Instrumentation by Prof Alok Barua, IIT Kharagpur (NPTEL Online Certification Course)
2. Industrial Instrumentation, Control and Automation by S Mukhopadhyay, S Sen and A K Deb, Jaico Publishing House
3. AK Sawhney Electrical& Electronic Measurement & Instrumentation, Dhanpat Rai Publishers
4. DVSMurthy, Transducers in Instrumentation, Prentice Hall, 1995.

COMPUTER COMMUNICATION NETWORKS					
Subject Code: BECEM1-006	**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. Sunilkumar 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.

ARTIFICIAL INTELLIGENCE

Subject Code: BECEM1-007	L	T	P	C	Duration: 60 Hrs.
	3	1	0	4	

Course Objectives:

1. To study the concepts of Artificial Intelligence.
2. To learn the methods of solving problems using Artificial Intelligence.
3. To introduce Image processing and NLP as application areas of AI.

Course Outcomes:

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

1. Apply the concepts of knowledge representation, planning and reasoning for real world applications.
2. Apply AI techniques to solve complex problems of Industry using machine learning.
3. Apply AI techniques to solve problems in Image Processing and NLP.
4. Learn to use AI with complete Ethics and Follow legal considerations.

UNIT-I (15 Hrs.)

Introduction to AI: Introduction to artificial intelligence, History, AI applications, Problem spaces and search, Knowledge and rationality, Heuristic search strategies, Search and optimization (gradient descent), Adversarial search, Planning and scheduling.

UNIT-II (15 Hrs.)

Knowledge Representation and Reasoning: Propositional logic, First-order logic, Knowledge representation, Quantifying uncertainty, Probabilistic reasoning.

UNIT-III (15 Hrs.)

Machine Learning

Supervised methods: What is machine learning, Supervised vs. unsupervised learning, Regression - linear, logistic, ridge, Classification – decision trees, SVM, random forests, Model performance evaluation – MSE, lift, AUC, Type 1 vs 2 errors.

Deep Learning: Neural networks and back-propagation, Convolutional neural networks, Recurrent neural networks and Long Short-Term Memory (***LSTM***) networks.

Machine Learning: Unsupervised Methods, Dimensionality reduction: PCA, Clustering – k-means, hierarchical clustering, Semi-supervised methods, Reinforcement learning, Choosing among machine learning techniques

UNIT-IV (15 Hrs.)

AI and Machine learning in industry

Image Processing: Introduction to computer vision, Image segmentation, Object and motion detection, Object classification.

Natural Language Understanding: Intro to natural language understanding, Application of deep learning to NLP.

Ethical and Legal Considerations in AI: Privacy, Bias, AI and the future of work, Appropriate uses of AI, Future of AI: Emerging developments.

Recommended Text Books / Reference Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach" , 3rd Edition,Prentice Hall, 2001
2. Goodfellow,I., Bengio, Y. and Courville A., "Deep Learning", MIT Press, 2016
3. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill, 2008
4. Trivedi, M.C., "A Classical Approach to Artifical Intelligence", Khanna Publishing House,Delhi.
5. Artificial Intelligence, George F. Luger, Pearson Education, 2001.

WIRELESS ADHOC & SENSOR NETWORKS					
Subject Code: BECEM1-008	**L**	**T**	**P**	**C**	**Duration: 60 Hrs.**
	3	1	0	4	

Course Objectives:

1. To provide knowledge of wireless adhoc & sensor networks
2. To understand wireless sensor network node architecture and network architecture
3. To become familiar with various protocols and applications of wireless sensor networks

Course Outcomes:

After the completion of the course, student/s shall demonstrate the ability/skills to:

1. Become familiar with wireless networks evolution and applications
2. Understand node and network architecture of wireless sensor networks
3. Learn various operating systems for wireless sensor network
4. Understand MAC, routing and transport protocols for wireless sensor networks
5. Learn real time applications of wireless sensor networks

UNIT-I (15 Hrs.)

Introduction to Wireless Networks: Background of wireless networks, OSI reference model, TCP/IP model, wireless technologies, wireless LAN, blue-tooth and personal area networks, adhoc networks, background of sensor networks technology, need, motivation and evolution of wireless sensor networks, advantages, applications, challenges and issues in wireless sensor networks.

Basic Wireless Sensor Network Technology: Basic sensor network architecture, motes, sensor devices, types of sensors, sensor's specifications, operating environment, wireless transmission technology and systems, hardware components and design constraints, operating systems and execution environments, sensing and communication range.

UNIT-II (15 Hrs.)

Wireless Sensor Network Architecture:

Architecture, traditional layered stack, cross-layer designs, Sensor node, commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot, IEEE standards for WSNs, physical layer and transceiver design considerations in WSNs, energy usage profile, choice of modulation scheme, antenna considerations.

Operating Systems for Wireless Sensor Networks:

Introduction, operating system design issues, examples of operating systems - TinyOS, Contiki, Mate, MagnetOS, MANTIS, OSPM, EYES OS, SenOS, EMERALDS, PicOS.

UNIT-III (15 Hrs.)

Medium Access Control Protocols for Wireless Sensor Networks: Performance requirements, common protocols, MAC Protocols for WSNs - schedule-based protocols, random access-based protocols, periodic listen and sleep operations, schedule selection and coordination, schedule synchronization, adaptive listening, access control and data exchange.

Routing Protocols for Wireless Sensor Networks: Routing challenges and design issues, WSN routing techniques, flooding and its variants, GLOSSY, sensor protocols for information via negotiation, power-efficient data gathering in sensor information systems.

UNIT-IV (15 Hrs.)

Transport Control Protocols for Wireless Sensor Networks: Traditional transport control protocols – TCP and UDP, feasibility of using TCP or UDP for WSNs, transport protocol design issues, examples of existing transport control protocols for WSNs – CODA, ESRT, RMST, PSFQ, GARUDA and ATP, problems with transport control protocols, performance of transport control protocols, congestion, packet loss recovery.

Topology control, clustering, time synchronization, localization and positioning, data storage and manipulation, data aggregation, WSN applications - home control, building automation, industrial automation, medical applications, reconfigurable sensor networks, highway monitoring, military applications, civil and environmental engineering applications, wildfire Instrumentation, habitat monitoring, nanoscopic sensor applications, case study: IEEE 802.15.4 LR-WPANs standard.

Recommended Text Books / Reference Books:

1. Wireless AdHoc and Sensor Networks by Prof Sudip Misra, IIT Kharagpur (NPTEL Online Certification Course)
2. Wireless Sensor Networks: Technology, Protocols, and Applications by Kazem Sohraby/wiley.
3. Wireless Sensor Networks by Zhao Feng/ Elsevier India
4. Security in Wireless Sensor Networks by Piotr Szczechowiak/ Lap Lambert Academic Publishing
5. Wireless Sensor Networks by Raghavendra SivalingamZnati/ Springer India
6. Building Wireless Sensor Networks by Robert Faludi/ O'reilly

VHDL DESIGN					
Subject Code: BECEM1-009	**L**	**T**	**P**	**C**	**Duration: 45 Hrs.**
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Course Objectives: This course is meant to provide fundamental knowledge to students for understanding of the various concepts and techniques used in VHDL Design:

1. To teach the students about CAD tools for digital system design.
2. To learn hardware description language VHDL for design of digital systems.
3. To model combinational and sequential digital systems using VHDL.
4. To learn and design dedicated and general-purpose microprocessor using VHDL.

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

1. Understand the hardware description language.
2. Model and design digital logic systems using VHDL.
3. Design of digital systems using ROMs, PALs, PLDs, etc.
4. Design and model dedicated and general-purpose microprocessor using VHDL

UNIT-I (10 Hrs.)

Introduction: Introduction to computer-aided design tools for digital systems, hardware description languages, introduction to VHDL, identifiers, data objects and classes, data types, operators, operator overloading, type conversion, types of delays, entity and architecture declaration, different styles of VHDL modelling: behavioural, dataflow and structural models, packages & libraries..

UNIT-II (12 Hrs)

VHDL Statements: Concurrent and sequential statements**,** signal and variable assignment statements, conditional statements, case statements, if statements, wait statement etc., arrays and loops, resolution functions, aliases, generics.

UNIT-III (12 Hrs)

Combinational Circuit Design: VHDL models and simulation of combinational circuits such as adders and subtractors, multiplexers, demultiplexers, encoders, decoders, code converters, comparators, implementation of functions using ROMS, PLAs, PALs, CPLDs and FPGAs.

Sequential Circuit Design: Use of signed and unsigned data types for sequential circuit design, VHDL models and simulation of sequential circuits like latches and flip-flops, registers and shift registers, counters, application of shift registers as counters, Register files, Static Random-Access Memory, Larger memories.

UNIT-IV (11 Hrs)

Design of Microprocessor using VHDL: Overview of microprocessor, designing of datapaths; dedicated and general purpose, VHDL design of control unit, design of dedicated and general-purpose microprocessor using VHDL.

Recommended Text Books / Reference Books:

1. IEEE Standard VHDL Language Reference Manual (1993)
2. “Fundamentals of Digital Logic with VHDL Design”: Brown and Vranesic; TMH (2000)
3. “Digital Design & Modelling with VHDL & Synthesis”: KC Chang; IEEE Computer Society Press.
4. “A VHDL Primmer”: Bhasker; Prentice Hall 1995
5. “Digital System Design using VHDL”, Charles. H. Roth; PWS (1998)
6. “VDHL-Analysis & Modelling of Digital Systems”: Navabi Z; McGraw Hill
7. “VHDL Programming by Example” IV-Edition: Perry; TMH (2002)

8. "Introduction to Digital Systems": Ercegovac. Lang & Moreno; John Wiley (1999)
9. "Digital Logic and Microprocessor Design with VHDL", E. O. Hwang", Thomson Engineering.

VHDL DESIGN LAB

Subject Code: BECEM1-053 | **L T P C** 0 0 2 1 | **Duration: 30 Hrs.**

Course Objectives:

1. To learn Hardware Descriptive Language (VHDL)
2. To learn the fundamental principles of VLSI circuit design in digital and analog domain.
3. To model combinational and sequential digital systems using VHDL.
4. To learn and design an exemplar microcomputer using VHDL.

Course Outcomes:

At the end of the course, the student should be able to:

1. Write VHDL code for basic as well as advanced digital circuits.
2. Model and Design digital logic systems using VHDL.
3. Design and Model customised microcomputer.

LIST OF EXPERIMENTS

1. Design of basic and universal Gates using behavioural/data flow modelling styles.
2. Design of Basic Gates using Universal gates using Structural modelling styles.
3. Design of Half-Adder, Full Adder, Half Substractor, Full Substractor and 4:1 Mux using basic gates.
4. Design of 3:8 Decoder and 8:3 Priority Encoder using behavioural/data flow modelling styles.
5. Design of 4 Bit Binary to Grey code Converter & BCD to Excess-3 Converter.
6. Design of all type of Flip-Flops using if-then-else CASE and WAIT VHDL Constructs.
7. Design of 8-Bit Shift Register with shift Right, shift Left, Load facility with Asynchronous/Synchronous set/reset.
8. Design of Synchronous 8-Bit universal shift register.
9. Design 8 bit Up/Down counters and various Truncated Sequence Counters.
10. Design of Shift Register as 8-bit Johnson Counter & 8-bit Ring Counter using VHDL.