Total Credits= 18

Semester 7th		Contact Hours			Max Marks		Total Marks	Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.		
BECED1-7XX	Departmental Elective-III	3	0	0	40	60	100	3
BECED1-7XX	Departmental Elective-IV	3	0	0	40	60	100	3
BECED1-7XX	Departmental Elective-V	3	0	0	40	60	100	3
XXXXX	Open Elective*	3	0	0	40	60	100	3
BECES1 -701	Project Stage-I	0	0	4	60	40	100	2
BMNCC0-002	Environmental Sciences (MC)	2	0	0	100	--	100	--
BECES1 -702	Training-III	--	--	--	60	40	100	4
Departmental Elective – III (Select any one)								
BECED1-711	Fiber Optic Communications							
BECED1-712	Mobile Communication and Networks							
Departmental Elective – IV (Select any one)								
BECED1-721	Parallel Processing							
BECED1-722	Scientific Computing							
BECED1-723	Neural Network & Fuzzy Logic							
Departmental Elective – V (Select any one)								
BECED1-731	VLSI Technology							
BECED1-732	CMOS Design							
BECED1-733	High Speed Electronics							
Total		**-**	**-**	**-**	**380**	**320**	**700**	**18**

***Open Elective Subjects may also be chosen from the list of Open Electives-I, II and III offered by other departments of university.**

Total Credits= 17

Semester 8th		Contact Hours			Max Marks		Total Marks	Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.		
BECED1-8XX	Departmental Elective-VI	3	0	0	40	60	100	3
BECED1-8XX	Departmental Elective-VII	3	0	0	40	60	100	3
XXXXX	Open Elective*	3	0	0	40	60	100	3
BECES1 -801	Project Stage-II	0	0	10	120	80	200	5
BMNCC0-006	Essence of Indian KnowledgeTradition (MC)	2	0	0	100	--	100	--
BHSMC0-024	Project Management and Entrepreneurship**	3	0	0	40	60	100	3
Departmental Elective – VI (Select any one)								
BECED1-811	Wireless Sensor Networks							
BECED1-812	Satellite Communication							
BECED1-813	Error correcting codes							
Departmental Elective – VII (Select any one)								
BECED1-821	Machine Learning							
BECED1-822	Data Mining & Big Data							
BECED1-823	Artificial Intelligence							
BECED1-824	Internet of Things							
Total		**-**	**-**	**-**	**380**	**320**	**700**	**17**

Note *(Applicable for 2019 Batch onwards)*: As per AICTE Activity Point Programme, a candidate has to earn 100 activity points (for Lateral Entry – 75 activity points) in addition to the required Academic Grades before he/she appears in his/her final examinations.

***Open Elective Subjects may also be chosen from the list of Open Electives-I, II and III offered by other departments of university.**

****Detailed syllabus of Humanities/Management subjects may be seen on the UG Open Electives Page of University website by clicking on "MRSPTU List of Humanities, Social Science and Management Subjects_BHSMC0-XXX"**

FIBRE OPTIC COMMUNICATIONS

Subject Code: BECED1-711 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (11Hrs)

Introduction to light and optical Fiber: Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, ray model, wave model.
Different types of optical fibres, modal analysis of a step index fibre, Signal degradation on optical fibredue to dispersion and attenuation, fabrication of fibres and measurement techniques like OTDR

UNIT-II (12 Hrs)

Optical Sources, Detectors and Optical Link Design: LEDs and Lasers, photo-detectors-pin diodes, APDs, detector responsivity, noise, optical receivers, optical link design-BER calculation, quantum limit, power penalties.

UNIT-III (10Hrs)

Optical switches & Amplifiers: Optical switches – coupled mode analysis of directional couplers, electro-optic switches. Optical Amplifiers - EDFA, Raman amplifier.

UNIT-IV (12Hrs)

Optical Communication System: WDM and DWDM systems. Principles of WDM networks, Nonlinear effects in fiber optic links, Concept of self-phase modulation, group velocity dispersion and solition based communication.

Text/Reference Books:

1. John M Senior, 'Optical Fiber Communications', PHI.
2. Gerd Keiser, 'Optical Fiber Communications', TMH.
3. G. Aggarwal, Fiber Optic Communication systems, John wiley and sons, New York, 1997.
4. John Gowar, Optical Communication Systems, PHI Publications.

MOBILE COMMUNICATION AND NETWORKS

Subject Code- BECED1-712 **L T P C** **Duration:-45 hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (10Hrs)

Introduction: - Cellular Concepts-Cell structure, frequency re-use, cell splitting, channel assignment, handoff, interference, capacity, power control, Wireless Standards: - Overview of 2G, 3G and 4G cellular standards.

UNIT-II (12Hrs)

Signal Propagation- Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

UNIT-III (11Hrs)

Capacity of flat and frequency selective channels. Antennas- Antennas for mobile terminal-mono pole antennas, PIFA, base station antennas and arrays.

Multiple access schemes- FDMA, TDMA, CDMA and SDMA. Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.

UNIT-IV (12Hrs)

Receiver structure- Diversity receivers- selection and MRC receivers, RAKE receiver, equalization; - Linear-ZFE and Adaptive, DFE. Transmit diversity- Altamonte scheme.

MIMO and Space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff. Performance measures- Outage, average SNR, average symbol/bit error rate. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

Text/Reference Books:-

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
2. WCY Lee, Mobile Communication Design Fundamentals, Prentice Hall, 1993.
3. Raymond Steele, mobile Radio Communication, IEEE Press, New York, 1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
5. VK Garg & JE Wilkes, Wireless and Personal Communication Systems, Prentice Hall, 1996.

PARALLEL PROCESSING

Subject Code: BECED1-721 **L T P C** **Duration: 45Hrs**

3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (11Hrs)

Theory of Parallelism: *Parallel Computer Models:* The State of Computing, Multiprocessors and Multicomputers, Multivectors and SIMD Computers, PRAM and VLSI Models. *Program and Network Properties:* Conditions of Parallelism, Program Partitioning

and Scheduling, Control Flow versus Data Flow, System Interconnect Architectures. *Principles of Scalable Performance:* Standard Performance Measures. Parallel Processing Applications – Massive Parallelism for Grand Challenges.

UNIT-II (11Hrs)

Speedup Performance Laws: Amdahl's Law for Fixed Workload, Gustafson's Law for Scaled Problems and Memory – Bounded Speedup Model. Scalability Metrics and Goals.

Processors and Memory Hierarchy: *Advanced Processor Technology:* Design Space of Processors, Instruction Set Architectures, CISC and RISC Scalar Processors.*Superscalar and Vector Processors:* Superscalar Processors, the VLIW Architecture. Memory Hierarchy Technology. *Virtual Memory Technology:* Virtual Memory Models, TLB, Paging and Segmentation, Memory Replacement Policies.

UNIT-III (11Hrs)

Bus, Cache and Shared Memory: *Cache Memory Organizations:* Cache Addressing Models, Direct Mapping and Associative Caches, Set-Associative and Sector Caches, Cache Performance Issues. *Shared-Memory Organizations*: Interleaved Memory Organization, Bandwidth and fault Tolerance, Memory Allocation Schemes. *Sequential and Weak Consistency Models:* Atomicity and Event Ordering, Sequential Consistency Model, Weak Consistency models.

UNIT-IV (12 Hrs)

Pipelining and Superscalar Techniques: *Linear Pipeline Processors:* Asynchronous and Synchronous Models, Clocking and Timing Control, Speedup, Efficiency and Throughput. *Nonlinear Parallel Processors:* Reservation and Latency Analysis, Collision-Free Scheduling.

Multiprocessors and Multicomputers: *Multiprocessor System Interconnects:* Hierarchical Bus Systems, Crossbar Switch and Multiport Memory, Multistage and Combining Networks. *Cache Coherence and Synchronization Mechanisms:* The Cache Coherence Problem, Snoopy Bus Protocols, Directory-based Protocols and Hardware Synchronization Mechanisms.

Text/Reference Books:

1. Kai Hwang, "Advanced Computer Architecture", McGraw Hill International, 1993.
2. William Stallings, "Computer Organization and Architecture", Macmillan
3. Publishing Company, 1990.
4. M. J. Quinn, "Designing Efficient Algorithms for Parallel Computers", McGraw
5. Hill International, 1994.
6. John L. Hennessy and David A. Patterson, Computer Architecture A Quantitative approach, Morgan Kaufman Publishers. Inc., 1990.
7. D.P. Siewiorek, G.G. Bell, A. Newell, Computer Structures, Principle and Examples, McGraw Hill, 1982.
8. Related IEEE/IEE publications

SCIENTIFIC COMPUTING

Subject Code: BECED1-722 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (11Hrs)

Introduction: Introduction to scientific computing, representing numbers in a computer: scalar data types; Variables and constants: guidelines for variable names, Assignment statements: mathematical and logical operators; Keyboard input and screen output; Writing a simple, linear program, Conditional statements; arrays and subscripts; loops. Plotting; Functions and subroutines.

UNIT-II (11Hrs)

Foundation of Scientific Computing: Quantum computing, Wentzel-Kramer-Brillouin Method, Runge-Kutta method, Trapezoidal method, Quasi-linear, Laplace equation, wave packets. Scientific elements of a FEM, Lagrange and hermite interpolations, Elliptic equation with linear basis function, Pressure fluctuation.

UNIT-III (12Hrs)

Scientific applications of computer programs: Introduction to Matlab, Solving nonlinear equations; Numerical integration; Data analysis, plotting and smoothing; simulating simple physical, chemical and/or mathematical systems. Simulation: the simple programming approach to difference equations, Differential Equations.

UNIT-IV (11 Hrs)

Numerical Differentiation, Construction of finite difference schemes, Pade Approximants, Error analysis Non-uniform grids.

Numerical Integration: Rectangular, Trapezoidal and Simpsons rule, Romberg integration and Richardson extrapolation, Gaussian quadrature, Adaptive quadrature, Error analysis

Text/Reference Books:

1. Approximation Theory and Approximation Practice, by Lloyd N. Trefethen
2. Applied Numerical Methods Using MATLAB, by Won Y. Yang, Wenwu Cao, Tae-Sang Chung, John Morris, Wiley.
3. Interpolation and Approximation by polynomials, by George M. Phillips
4. Numerical Analysis (7th) by R. Burden and J. Faires
5. Numerical mathematics and computations, by W. Cheney, D. Kincaid, Thomson, Brooks/Cole.

NEURAL NETWORK & FUZZY LOGIC

Subject Code: BECED1-723 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (10 Hrs)

Introduction to Neural Networks: Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential, Applications of ANN.

Types of Learning: Supervised, Unsupervised learning, Basic Learning laws, Hebb's rule, Delta rule, Widrow and Hoff LMS learning rule, Correlation learning rule instar and ouster learning rules, Competitive Learning, Reinforcement Learning.

UNIT-II (15 Hrs)

Multilayer Perceptron: Perceptron, Feed forward Neural Network, Multilayer Perceptron, Error Back propagation Learning Algorithm, MLP design issues and implementation in various applications.

Other ANNs: K-means clustering algorithm, Kohonen's feature maps. ART networks, Radial Basis Function Nets- recurrent networks, Hopfield Neural Nets, Associative and Hetro-associative memories, Applications of ANN in pattern recognition, optimization, control etc

UNIT-III (12 Hrs)

Fuzzy Algebra: Fuzzy algebra fundamental concepts, Classical sets, Fuzzy sets, Fuzzy relations, Fuzzification, Defuzzification,

Fuzzy Logic Systems: Membership functions, Fuzzy rules and Knowledge base, Fuzzy Inference System, applications of Fuzzy logic in real world problems, Fuzzy logic control and its comparison with PID control.

UNIT-IV (8 Hrs)

Neuro-fuzzy network, Genetic Algorithms, and their applications.

Text/Reference Books:

1. Berkin Riza C and Trubatch, "Fuzzy System design principles- Building Fuzzy IF-THEN rule bases", IEEE Press.
2. Yegna Narayanan, "Artificial Neural Networks". 8th Printing. PHI(2003)
3. Patterson Dan W, "Introduction to artificial Intelligence and Expert systems", 3rd Ed., PHI
4. Simon Haykin, "Neural Networks" Pearson Education.
5. Yen and Langari, "Fuzzy Logic: Intelligence, Control and Information", Pearson Education.
6. Jacek M Zaurada, "Introduction to artificial neural Networks, Jaico Publishing Home, Fouth Impression.

VLSI TECHNOLOGY

Subject Code: BECED1-731 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT I (12 Hrs.)

Crystal Growth: Introduction, Electronic-Grade Silicon, Czochralski and Bridgman Growth, Crystal Evaluation, Silicon Shaping and Wafer Preparation.

Epitaxial Growth: Thermodynamics of vapour phase growth, selective growth, MOCVD, molecular beam epitaxy technology, gas source MBE and chemical beam epitaxy. Epitaxial evaluation.

Oxidation: Deal-Grove model, linear and parabolic rate coefficients, oxide characterization, types of oxidation and their kinematics, Thin oxide growth, Oxidation of polysilicon, oxidation induced stacking faults, oxidation techniques and systems.

UNIT II (12 Hrs.)

Etching: Wet etching, basic regimes of plasma etching, reactive ion etching and its damages, lift-off, and sputter etching.

Lithography: Optical, electron, X-ray and ion-beam, contact/proximity and projection printers, advanced mask concepts, alignment**.**

Dielectric and Polysilicon Film Deposition: Deposition Processes, Plasma-Assisted Depositions, silicon dioxide, silicon nitride and polysilicon depositions

UNIT III (11 Hrs.)

Diffusion and Ion-Implantation: Fick's diffusion law, atomistic model, diffusion coefficient of common dopants and diffusion systems. Scattering phenomenon, projected range, channeling and lateral projected range, implantation damage, problems and concerns in ion-implantation systems.

Metallization: Applications and choices, physical vapor deposition, patterning, problem areas, multilevel metallization.

UNIT IV (10 Hrs.)

VLSI Process Integration: NMOS and CMOS IC technology, MOS memory IC technology, bipolar IC fabrication.

Assembly Technique and Packaging: Package types, packaging design consideration, VLSI assembly technologies.
Yield and Reliability: Yield loss in VLSI, yield loss modeling, reliability requirements, accelerated testing, BIST.

Text/Reference Books:

1. Sze, S.M., "VLSI Technology", 4th Ed., Tata McGraw-Hill
2. Tyagi, M.S., "Introduction to Semiconductor Materials and Devices", John Wiley & Sons.
3. Chang, C.Y. and Sze, S.M., "ULSI Technology", McGraw-Hill.
4. Campbell, S.A., "The Science and Engineering of Microelectronic Fabrication", 4th Ed., Oxford University Press.
5. Plummer, J.D., Deal, M.D. and Griffin, P.B., "Silicon VLSI Technology: Fundamentals, Practice and Modeling", 3rd Ed., Prentice-Hall.
6. Chen W.K. (ed.), "VLSI Technology", CRC Press.

CMOS DESIGN

Subject Code: BECED1-732 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT I (12 Hrs.)

Review of MOS Devices: MOS structure, enhancement & depletion transistor, threshold voltage, MOS I-V and C-V characteristics, MOS device design equations, non-ideal behaviour of MOS, CMOS inverter and DC characteristics, beta ratio effects and noise margin.

UNIT II (12 Hrs.)

CMOS Fabrication Technology: CMOS fabrication process, CMOS layout design rules, CMOS process enhancements, fabrication issues, delay models: RC delay model, linear delay model, delay in a multistage logic network, power estimation, static and dynamic power, energy delay optimization, low power architectures, interconnects and their delay, energy and noise impacts, variability and reliability issues, transistor scaling.

UNIT III (11 Hrs.)

Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic, circuit issues, combinational logic function, static complementary gate structure and layouts of different logic gates, delay and transmission times, speed power product.

UNIT IV (10 Hrs.)

Sequential Circuit Design: Static and dynamic latches and registers, pulsedlatches, resettable enabled latches and registers, differential flip-flops, choice of elements, sequencing dynamic circuits.

Text/Reference Books:

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th Edition, Pearson Education India, 2011.
2. C.Meadand, L.Conway, Introduction to VLSI Systems, Addison Wesley, 1979.
3. J.Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.
4. P. Douglas, VHDL: Programming by Example, McGraw Hill, 2013.
5. L. Glaserand, D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985.

HIGH SPEED ELECTRONICS

Subject Code: BECED1-733 **L T P C** **Duration: 45 Hrs.**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (10 Hrs.)

Introduction: Need of high speed electronic design and interconnect design, basics of transmission line theory, transmission line structures on PCB and MCM, transmission line parameters, wave propagation, reflections from transmission lines, effect of rise time, reflections from resistive, capacitive, inductive loads, reflection minimizations, crosstalk and associated noise, crosstalk induced, flight time and signal integrity issues, cross talk minimization, termination of transmission line pairs.

UNIT-II (10 Hrs.)

Non ideal Interconnect Issues: Transmission line losses, effect of dielectric constant and serpentine traces and bends on transmission behavior, inter-symbol interference, topological effects, impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency power delivery, local decoupling requirements for high speed input-output, SSO/SSN, characteristics of passive devices: interconnects at RF frequencies, resistors, capacitors, inductors and transformers, interconnect options at high frequency.

UNIT-III (10 Hrs.)

Design Methodologies for High-Speed Buses: Basics of digital timing analysis, timing and signal quality metrics, test loads, design optimization and sensitivity analysis, radiated emissions and mechanism, chocking and decoupling at low as well as

high frequencies, package/enclosure considerations, spread spectrum clocking, specifications, minimizing system noise.

UNIT-IV(15Hrs.)

RF Amplifier Design: Low noise amplifiers, LNA topologies, noise optimization, linearity and large signal performance, RF power amplifiers: class A, B, AB. C, D, E and F amplifiers, integrated circuit realizations, cross-over distortion, efficiency, RF power output stages.

Mixers: Mixer fundamentals, up-conversion, down-conversion, nonlinear system as linear mixer, multiplier based mixers, subsampling mixers, conversion gain and spurious response.

Oscillator: General considerations of oscillators, purely linear oscillators, issues, describing functions for bipolar and MOS based oscillators, tuned oscillators, resonators, quadrature signal generation.

Text/Reference Books:

1. Stephen H. Hall, Garrett W. Hall, James A. McCall "High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices", August 2000, Wiley-IEEE Press.
2. Thomas H. Lee, "The Design of CMOSRadio-Frequency Integrated Circuits", Cambridge University Press, 2004, ISBN 0521835399.
3. Behzad Razavi, "RF Microelectronics", Prentice-Hall 1998, ISBN0-13-887571-5.
4. Guillermo Gonzalez, "Microwave Transistor Amplifiers", 2nd Edition, Prentice Hall.
5. Kai Chang, "RF and Microwave Wireless systems", Wiley.
6. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India,2011

ENVIRONMENTAL SCIENCES

Subject Code: BMNCC0-002 **L T P C** **Duration: 30 Hrs.**

2 0 0 0

Course Objectives: ----------

Course Outcomes: ----------

. UNIT-I

1. The Multidisciplinary Nature of Environmental Studies:

Definition, scope and importance, Need for public awareness.

2. **Natural Resources**

Renewable and Non-renewable Resources: Natural resources and associated problems.

(a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

(b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

(c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

(d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

(e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies.

UNIT-II

Environmental Pollution: Definition

(a) Causes, effects and control measures of:

i) Air pollution

ii) Water pollution

iii) Soil pollution

iv) Marine pollution

v) Noise pollution

vi) Thermal pollution

vii) Nuclear pollution

(b) **Solid Waste Management**: Causes, effects and control measures of urban and industrial wastes.

(c) Role of an individual in prevention of pollution.

(d) Pollution Case Studies.

(e) Disaster management: floods, earthquake, cyclone and landslides.

UNIT-III

Social Issues and the Environment

(a) From unsustainable to sustainable development

(b) Urban problems and related to energy

(c) Water conservation, rain water harvesting, Watershed Management

(d) Resettlement and rehabilitation of people; its problems and concerns, Case studies.

(e) Environmental ethics: Issues and possible solutions

(f) Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies.

(g) Issues involved in enforcement of environmental legislation

UNIT-IV

Human Population and the Environment

(a) Population growth, variation among nations

(b) Population explosion – Family Welfare Programmes

(c) Environment and human health

(d) Human Rights

(e) Value Education

(f) Women and Child Welfare

(g) Role of Information Technology in Environment and Human Health

(h) Case Studies.

Environmental Science related activities:

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around US. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethoses. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two types of activities.

(a) Awareness Activities:

i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste.

ii) Slogan making event

iii) Poster making event

iv) Cycle rally

v) Lectures from experts.

(b) Actual Activities:

i) Plantation

ii) Gifting a tree to see its full growth

iii) Cleanliness drive

iv) Drive for segregation of waste

v) To live some big environmentalist for a week or so to understand his work

vi) To work in kitchen garden for mess

vii) To know about the different varieties of plants

viii) Shutting down the fans and ACs of the campus for an hour or so

Recommended Books

1. Agarwal, K. C. 2001 Environment Biology, Nidi Publ. Ltd. Bikaner.
2. Jadhav, H & Bhosale, V.M. 1995. Environment Protection and Laws. Himalaya Pub House, Delhi 284p.
3. Rao M. N. & Datta A.K. 1987. Waste Water Treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345 p.
4. Principle of Environment Science by Cunninghan, W.P.
5. Essentials of Environment Science by Joseph.

8TH SEMESTER

WIRELESS SENSOR NETWORKS

Subject Code: BECED1-811 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (13 Hrs)

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks. Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.

UNIT-II (11 Hrs)

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee, Dissemination protocol for large sensor network.

UNIT-III (11 Hrs)

Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols. Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.

UNIT-IV (10 Hrs)

Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC.

Text/Reference Books:

1. WaltenegusDargie , Christian Poellabauer, “Fundamentals Of Wireless Sensor Networks TheoryAndPractice”,ByJohnWiley&SonsPublications,2011
2. SabrieSoloman, “Sensors Handbook" by McGraw Hill publication.2009
3. FengZhao,LeonidasGuibas,“WirelessSensorNetworks”,ElsevierPublications,2004
4. Kazem Sohrby, Daniel Minoli, “Wireless Sensor Networks”: Technology, Protocols and Applications, Wiley-Interscience
5. PhilipLevis,AndDavidGay"TinyOSProgramming”byCambridgeUniversityPress2009

SATELLITE COMMUNICATION

Subject Code: BECED1-812 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (10Hrs)

Introduction to Satellite Communication: Principles and architecture of satellite communication, brief history of satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

UNIT-II (12Hrs)

Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity of a satellite, concept of Solar day and Sidereal day.
Satellite sub-systems: Study of Architecture, and roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), communication sub-system, power sub-system.

UNIT-III (12Hrs)

Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effect, remedies for eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.
Satellite Link Budget: Flux density and received signal power equations, calculation of system noise temperature for satellite receiver, noise power calculation, drafting of satellite link budget, C/N ratio calculations in clean air and rainy conditions

UNIT-IV (11Hrs)

Modulation and Multiple Access Schemes: Various modulation schemes used in satellite communication, multiple access schemes: TDMA, FDMA and CDMA.
Text/Reference Books:

1. Timothy Pratt, 'Satellite Communication', John Wiley & Sons.
2. D.C. Aggarwal, 'Satellite Communication', Khanna Publishers.
3. Tri. T. Ha, "Digital Satellite Comunications", Tata Mcgraw Hill, 2009.
4. Dennis Roddy, Satellite Communication, Tata Mcgraw Hill, 2009

ERROR CORRECTION CODING

Subject Code: BECED1-813

L	T	P	C
3	0	0	3

Duration: 45 Hrs.

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (9 Hrs.)

Channel capacity and coding: Introduction; Channel Models, Channel Capacity, Need of Channel Coding, Information Capacity Theorem, Shannon Limit; Random Selection of Codes, Hamming Distance, overview of Information Theory. Classification of error correcting codes (ECC), Linear and non-linear codes, memory-based and memory-less codes, Symmetric and asymmetric codes, perfect and quasi perfect codes, coding efficiency; **Applications of error control coding**

UNIT-II (12 Hrs.)

Block Codes: Digital Communication Channel, Introduction to Block Codes, Single Parity Check Codes, Product Codes, Repetition Codes, error detection and correction, Hamming Codes, Minimum Distance of Block Codes, bounds on the size of a block code; bounded and maximum-likelihood decoding of binary block codes, Soft - Decision Decoding, Automatic Repeat Request

Schemes.

Linear Codes: Definition of Systematic Linear Codes, generator and parity check matrices, Standard Array decoding, Parity - Check Matrices, Syndrome decoding on symmetrical channels, Shortened and Extended Linear Codes.

UNIT-III (12 Hrs.)

Cyclic codes: Introduction of Cyclic Codes, Polynomials, Generator Polynomials, Encoding Cyclic Codes, Decoding Cyclic Codes, Factors of X^n +1, Parity-Check Polynomials, Dual Cyclic Codes, Generator and Parity-Check Matrices of Cyclic Codes.

BCH Codes: Linear Algebra, Galois Field, Definition and Construction of Binary BCH Codes, Error Syndromes in Finite Fields, Decoding Single error correction (SEC) and Double Error Correction (DEC) codes, Reed- Solomen Codes.

UNIT-IV (12 Hrs.)

Convolutional Codes: Introduction to Convolution codes, Encoding, Generator Matrices, Generator Polynomials, Graphical Representation of Convolutional Codes (code tree, state diagram, trellis diagram), Viterbi decoding algorithm. Concept of Interleaver and punctured coding

Concatenated codes: Introduction, Need and Purpose of concatenated codes, Overview of Turbo coders and decoders, LDPC coders and decoders, Recent trends in error correction coding.

Recommended Text Books / Reference Books:

1. Amitabha Bhattacharya, "Digital Communication", Tata McGraw Hill Publishing Company Limited, 2006.
2. Hwei P. Hsu, "Analog and Digital Communications", Schaum's Outline Series, McGraw Hill, 2nd Ed., 2003.
3. Shu Lin, Daniel J. Costello, Jr., "Error Control Coding", Second Edition, Pearson Education, 2011.
4. Martin Tomlinson, Cen Jung Tjhai, Marcel A. Ambroze, Mohammed Ahmed, Mubarak Jibril, "Error-Correcting Coding and Decoding: Bounds, Codes, Decoders, Analysis and Applications", Springer Nature, 2017.
5. Bose Ranjan, "Information Theory, Coding and Cryptography", Tata McGraw-Hill, 1st Ed., 2007.
6. Sklar Bernard, "Digital Communications - Fundamentals and Applications", Pearson Education-LPE, 2nd Ed., 2009.
7. F. J. McWilliams and N.J.A. Slone, "The Theory of Error Correcting Codes", 1977.
8. R.E. Balahut, "Theory and Practice of Error Control Codes", Addison Wesley, 1983.

MACHINE LEARNING

Subject Code: BECED1-821 **L T P C** **Duration: 45 Hrs**

3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (10 Hrs)

Basic concepts of data mining, including motivation and definition; different types of data repositories; data mining functionalities.

Data: Types of data and data quality; Data Preprocessing: data cleaning, data integration and transformation, data reduction, discretization and concept hierarchy generation; Exploring Data: summary statistics, visualization, multidimensional data analysis

UNIT-II (12 Hrs)

Supervised learning- Perceptron learning, single l layer/multilayer perceptron, linear separability, hidden layers, Error backpropagation algorithm, Radial Basis Function network; Unsupervised learning - Kohonen, SOM, Counter-propagation, ART, Reinforcement learning, adaptive resonance architecture, applications of neural networks to pattern recognition systems such as character recognition, face recognition, application of neural networks in imageprocessing.

UNIT-III (10 Hrs)

Clustering- Concept of Clustering, clustering process, clustering algorithms, Clustering largedatasets*;* measures of similarity, Clustering algorithms: Partitioning methods - k-means and k-medoids.

UNIT-IV (13 Hrs)

Classification: Binary Classification - Basic concepts, Bayes theorem and Naive Bayes classifier, Association based classification, Rule based classifiers, Nearest neighbour classifiers, Decision Trees, Random Forest; Perceptron; Multi-category classification; Model overfitting, Evaluation of classifier performance - Cross validation, ROC curves.

Text/Reference Books:

1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining. Pearson (2005),India. ISBN978-8131714720
2. JiaweiHanandMichelineKamber,DataMining:ConceptsandTechniques,MorganKaufmann,3rdedition (July 2011). 744 pages. ISBN978-0123814791
3. IanH.WittenandEibeFrank,DataMining:PracticalMachineLearningToolsandTechniques,Morgan Kaufmann, 3rd edition (January 2011). 664 pages. ISBN978-0123748560.
4. David E. Goldberg, Genetic Algorithms in Search, Optimization & Machine Learning, AddisonWesley, 1997.

DATA MINING & BIG DATA

Subject Code: BECED1-822 **L T P C** **Duration: 45Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (11Hrs)

Introduction: Data Mining as the Evolution of Information Technology, Kinds of Data, Major Issues and Challenges involved in Data Mining, Data Objects and Attribute Types.

Data Preprocessing: Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization. Association Rule Mining.

UNIT-II (11Hrs)

Data Warehousing: Basic Concepts, Modeling: Data Cube and OLAP, Design and Usage.

Classification: Basic Concepts, Decision Tree Induction, Bayes Classification Methods, Rule-Based Classification, K-Nearest Neighbor, Support Vector Machine, Model Evaluation and Selection, Techniques to Improve Accuracy.

UNIT-III (11Hrs)

Introduction to Big Data: Origin of Big Data, Big Data Analytics and Machine Learning; Big Data Analytics and Cloud Computing, Sources of Data Generation, Types: Structured, Unstructured, Semi-Structured Data. Issues, Challenges and Introduction to Enabling Technologies for Big Data.

UNIT-IV (12 Hrs)

Big Data Platforms and Applications: Introduction to Big Data Platforms, Big Data Storage Platforms for Large Scale Data Storage, Big Data Streaming Platforms for Fast Data, Big Data Applications and Machine Learning.

Text/Reference Books:

1. Jiawei Han, Micheline Kamber and Jian Pei. Data Mining Concepts and Techniques. Morgan Kaufmann Publishers.
2. Rajkumar Buyya, Rodrigo N. Calheiros and Amir Vahid Dastjerdi. Big Data Principles and Paradigms. Morgan Kaufmann Publishers.
3. Frank Ohlhorst. Big Data AnalyticsTurning Big Data into Big Money. Willey Publisher.
4. NPTEL Couse: Data Mining by PROF. PABITRA MITRA Department of Computer Science

and Engineering IIT Kharagpur.*(https://nptel.ac.in/courses/106/105/106105174/)*

5. NPTEL Couse: Big Data Computing by Prof. Rajiv Misra, Department of Computer Science and Engineering, IIT Patna.*(https://nptel.ac.in/courses/106/104/106104189/)*

ARTIFICIAL INTELLIGENCE

Subject Code: BECED1-823 **L T P C** **Duration: 45 Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (10 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 (8 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 (12 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,

Text/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.

INTERNET OF THINGS

Subject Code: BECED1-824 **L T P C** **Duration: 45Hrs**
3 0 0 3

Course Objectives: ----------

Course Outcomes: ----------

UNIT-I (11Hrs)

Introduction to Internet of Things (IoT): Definition, Characteristics, Evolution, Applications, IoT versus M2M (Machine to Machine) and IoT versus WoT (Web of Things). Sensing, Actuation, Sensors: Definition, Features, Classes. Sensor versus Transducers, Sensor Networks, UAV Networks, Actuator: Definition, Types (hydraulic, pneumatic, electrical, thermal, magnetic and mechanical).

Basics of IoT Networking: IoT Components, IoT Categories (Industrial and Consumer).Connectivity Technologies: LAN, WAN, Node, Gateway and Proxy, IPv4 versus IPv6. Communication Protocols.

UNIT-II (11Hrs)

Machine-to-Machine Communications: Introduction, Applications, Features. Interoperability in IoT: Current Challenges in IoT, Requirement, Types (User and Device).

Introduction to Arduino: Features, Types of Arduino Board. Programming, Integration of Sensors and Actuators with Arduino, Introduction to Python Programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi.

UNIT-III (11Hrs)

Software-Defined Networking (SDN): Current Network and its limitations, Introduction toSDN, Current Network to SDN, SDN Architecture, Components of SDN, Rule Placement with OpenFlow, SDN for IoT, Benefits of Integrating SDN with IoT, Data Handling and Analytics, Cloud Computing-Service Models, Comparison of Different Service Models, Sensor-Cloud.

UNIT-IV (12 Hrs)

Fog Computing: Introduction, Architecture and working of Fog, Advantages and Applications of Fog, Smart Cities and Smart Homes, IoT Challenges in Smart Cities, Data Fusion and its Opportunity in IoT, Connected Vehicles, Smart Grid, Industrial IoT, Case Study: Agriculture, Healthcare and Activity Monitoring.

Text/Reference Books:

1. Raj Kamal, "Internet of Things - Architecture and Design Principles" McGrawHill
2. Mayur Ramgir, "Internet of Things - Architecture, Implementation, and Security", First Edition, Pearson Education.
3. Olivier Hersent, David Boswarthick andOmar Elloumi, "The Internet of Things: Key Applications and Protocols", 2nd Edition, Wiley.
4. ArsheepBahga and Vijay Madisetti "Internet of Things: A Hands-On Approach" Orient Blackswan Publishers.

MOOCs Course Mapping:

"Introduction to Internet of Things" by Prof. Sudip Misra, Department of Computer Science and Engineering, IIT Kharagpur***(https://nptel.ac.in/courses/106/105/106105166/)***

ESSENCE OF INDIAN KNOWLEDGE TRADITION

Subject Code- BMNCC0-006 **L T P C** **Duration: 30 Hrs.**
2 0 0 0

Course Objectives: ----------

Course Outcomes: ----------

COURSE CONTENTS:

UNIT – I

Introduction to Indian Philosophy: Basics of Indian Philosophy, culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian culture, Ancient Indian, Medieval India, Modern India.

Indian Philosophy & Literature: Vedas Upanishads, schools of Vedanta, and other religion Philosophical Literature. Philosophical Ideas the role of Sanskrit, significance of scriptures to current society, Indian Philosophies, literature of south India.

UNIT – II

Religion and Philosophy: Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)

UNIT – III

Indian Fine Arts & Its Philosophy(Art, Technology & Engineering): Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in Indian, development of science in ancient, medieval and modern Indian.

UNIT – IV

Education System in India: Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Scientists of Medieval India, Scientists of Modern India. The role Gurukulas in Education System, Value based Education.

RECOMMENDED BOOKS:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition'', ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN-13:978-8187276333,2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre'', ISBN 81-7450-494-X, 2006
4. S. Narain, "Examination in Ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M.Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN-13: 978- 8120810990,2014
7. Chatterjee. S & Dutta "An Introduction to Indian Philosophy".